Pediatric Orthopaedic Trauma

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Abstract

Trauma patients that require pediatric intensive care unit services are likely to have significant orthopaedic injuries, and treatment of those injuries is increasingly likely to involve close coordination with orthopaedic surgery. This chapter on PEDIATRIC ORTHOPAEDIC TRAUMA focuses on the most common injuries that the pediatric intensivist will encounter in such situations. Available evidence that focuses on diagnosis, treatment, and clinical outcomes will be summarized.

Keywords

Orthopaedic injuries • Fractures • Trauma • Compartment syndrome

Introduction

The interface between the pediatric intensivist and the pediatric orthopaedic traumatologist is an all too common one. Orthopaedists are proud of the impact that modern advanced trauma life support programs have had on polytrauma patients [1]. Recent data from a large nationwide pediatric database review from the United States shows that out of about 8.5 million injured children per year, over 160,000 require hospitalization [2]. The most likely type of major operative procedure that pediatric trauma victims will undergo is orthopaedic surgery [3]. Half of all pediatric trauma victims will also suffer long-term sequelae from their injuries, and many will also suffer posttraumatic stress disorder [4, 5]. Childhood obesity has also emerged as a separate risk factor for extremity fractures and need for orthopaedic surgical intervention [6]. The rate and severity of pediatric musculoskeletal injury has seemed to keep pace with the increased popularity of extreme sports, motorized recreational vehicle use, and similar activities. All-terrain vehicle (ATV) injuries illustrate a particularly nasty subset of these pediatric trauma patients [7]. This chapter will review key aspects of pediatric orthopaedic trauma, focusing on current clinical evidence as it relates to pediatric critical care.

Pediatric Polytrauma

Pediatric polytrauma scenarios illustrate some of the most dangerous circumstances for patients and the most challenging for the larger critical care team. Only 170 verified pediatric trauma centers exist within the United States (41 states and the District of Columbia have one or more pediatric trauma centers) [8]. Even within those states that have pediatric trauma centers, many children continue to be treated at non-trauma center facilities [9]. Trauma remains the leading cause of death in children in the United States [10, 11].

Beyond the acute resuscitation phase, treatment decisions must be truly multidisciplinary in nature in order to optimize care. This has been termed the "collaborative model". Dr J Michael Dean (a pediatric intensivist) has said, "The surgeon should be a welcome partner in the PICU, and I think that the

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intensivist should put on surgical scrubs and join the surgical team in the operating room. Intimate knowledge of events in the operating room will improve the ability of the intensivist to care for the patient after surgery; likewise, knowledge of the ICU course will help the surgeon provide optimal care" [12]. A child with concomitant closed head injury, intra-abdominal injury, and pelvic fractures represents a prime example where such orchestration is indeed vital.

Head and neck related injuries (followed closely by extremity fractures) are the predominant injuries sustained by pediatric multiple trauma victims [7, 13]. Both short-term and long-term outcomes following pediatric multiple trauma are driven largely by head trauma severity [14–16]. Multiple studies have shown that early hypotension is strongly associated with worsened neurologic outcomes in head injured children [17–21]. Thus the potential value of orthopaedic surgical procedures aimed at fracture fixation must be weighed against the likelihood of deleterious neurologic effects secondary to hypotension [22]. Continuous intracranial pressure (ICP) monitoring during surgery, appropriate fluid management, and orthopaedic procedures aimed at minimizing blood loss are key elements to success.

Intra-abdominal [23] and pelvic injuries [24, 25] also present special concerns in the pediatric multiple trauma patient. The liver and spleen of children are less well protected due to proportionate size differences of the immature rib cage [26]. Nonoperative treatment protocols predominate [27] and necessitate certain activity restrictions that must be respected by the pediatric orthopaedic team [11]. A well-established relationship exists between thoracolumbar fractures (especially pediatric Chance fractures) secondary to lap belts and intra-abdominal injury [28–32]. When a seat belt sign (transverse lower abdominal linear ecchymosis) is present, more than 50 % of patients will have a confirmed intra-abdominal injury (including mesenteric or bowel injury, spleen and hepatic injuries) and at least 20 % of patients will require laparotomy [33]. A high index of suspicion must be maintained, communicated, and acted upon in a multidisciplinary fashion. A frequent scenario is that of initial recognition of the lap belt-related vertebral fracture followed by subsequent identification of intra-abdominal injury.

Femur Fractures

Femoral shaft fractures have consistently been the most common reason for pediatric orthopaedic in-patient admission at pediatric institutions [34, 35]. Femoral shaft fractures are also extremely common in pediatric multiple trauma victims [7, 10, 13, 27]. They represent disruption of the largest long-bone in the body and are accompanied by varying degrees of trauma to its surrounding soft tissue envelope. Significant amounts of blood can be lost due to femoral shaft fractures. However hemodynamic instability has been shown to not be due to isolated femoral bleeding, but rather it is indicative of more threatening abdominal or retroperitoneal injuries [36–39]. It has also been shown that hypotension may be an important indicator of head injury in pediatric patients [40]. Therefore, the likelihood of the need for pediatric general surgery or neurosurgery is much greater than the pediatric orthopaedist in these circumstances.

Near the time of initial presentation critical issues include splinting the fracture for purposes of pain control and limiting further soft tissue injury, ensuring adequate fluid resuscitation, and ruling out other organ system injury. Although a seemingly time-honored device, the Hare traction splint may be misapplied over 60 % of the time, thus making a case for proper training or expansion of the trauma splint armamentarium [41]. Under optimal conditions early fracture stabilization is desirable for purposes of pain control as well as speeding conversion to the rehabilitative phase. Separate from these goals, early (<24 h) versus late (≥24 h) surgery has not been shown to influence pediatric trauma outcomes [42, 43]. For patients too physiologically unstable for definitive surgery, bedside application of an external fixator will allow the patient to be mobilized for tertiary imaging *vis a vis* abdominal or neurologic injuries. Specific fracture stabilization methods will vary with the age of the patient, but most patients are currently treated surgically with intramedullary devices [44] (Fig. 19.1). Such femoral shaft fracture fixation techniques typically allow the patient to be up to a chair immediately and up with crutches or a walker (with protected weight-bearing) soon thereafter.

Distal femur growth plate fractures are a somewhat less common but much higher risk fractures when compared to femoral shaft fractures. Displaced physeal fractures of the distal femur are routinely associated with growth arrest rates in the 50 % range [45]. This is one of the most rapidly growing growth plates in the body, contributing 10 mm or more of femoral length each year. Therefore the consequences of growth disturbance can be devastating to a young child (Fig. 19.2). Anatomic reduction and stable internal fixation (often with a supplementary above knee cast) are the industry standard for treating these fractures. After satisfactory fracture healing these patients deserve radiographic screening for distal femoral growth arrest near the 6 months anniversary and 12 months anniversary of their injury.

Pelvic Trauma

Pediatric hip and pelvic trauma present a mixture of emergent, urgent, and late (follow-up) treatment issues. Emergent issues include those related to hemodynamic instability and resuscitation. It has been stated that the principles of management of pediatric pelvic disruptions should not differ

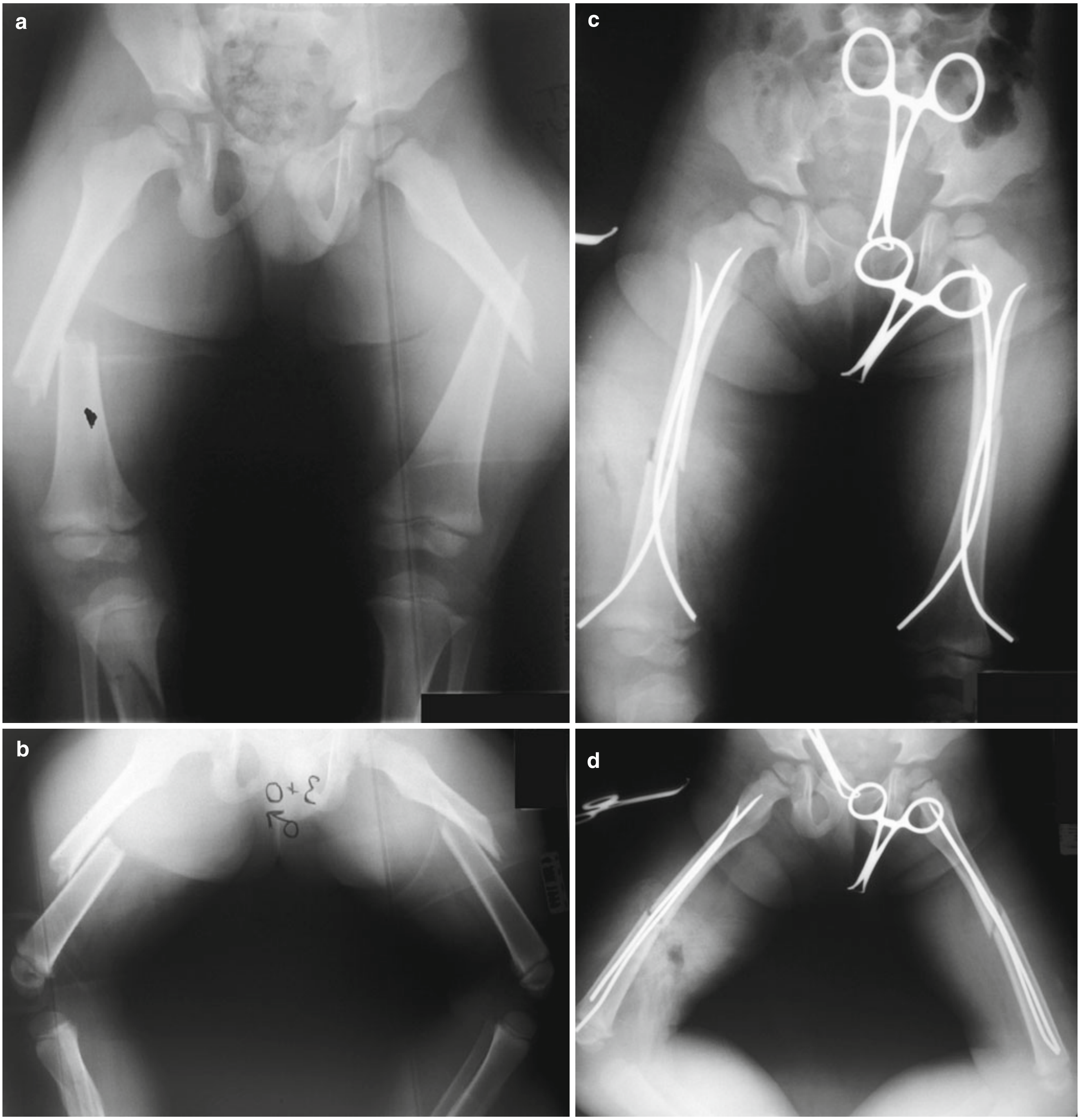

Fig. 19.1 A 3-year-old male multiple trauma victim whose injuries included bilateral femoral shaft fractures. (**a**) Initial injury AP radiograph demonstrating transverse right and oblique left femoral shaft fractures. (**b**) Initial injury lateral radiograph of both femur fractures (the right one was also a Type I open fracture). (**c**) Post-operative AP radiograph demonstrating elastic stable intramedullary nail (ESIN) fixation – also known as Nancy Nails as they were developed in Nancy, FRANCE. (**d**) Post-operative lateral radiograph – following such fracture stabilization the child may now be immediately transferred from bed to chair as indicated

greatly from adult principles [46]. Specifically, if pelvic instability is suspected, measures as simple as snuggly towel clipping a folded sheet around the pelvis may be very useful. If other explanations for hemodynamic instability have been ruled out [47, 48] and concern persists regarding displaced pelvic fractures, then a simple stabilizing pelvic external fixation frame should be applied [49, 50]. However beyond this acute phase some studies have shown that it is difficult to clearly establish that operatively treated patients enjoy better long-term clinical outcomes [51]. Other reports have

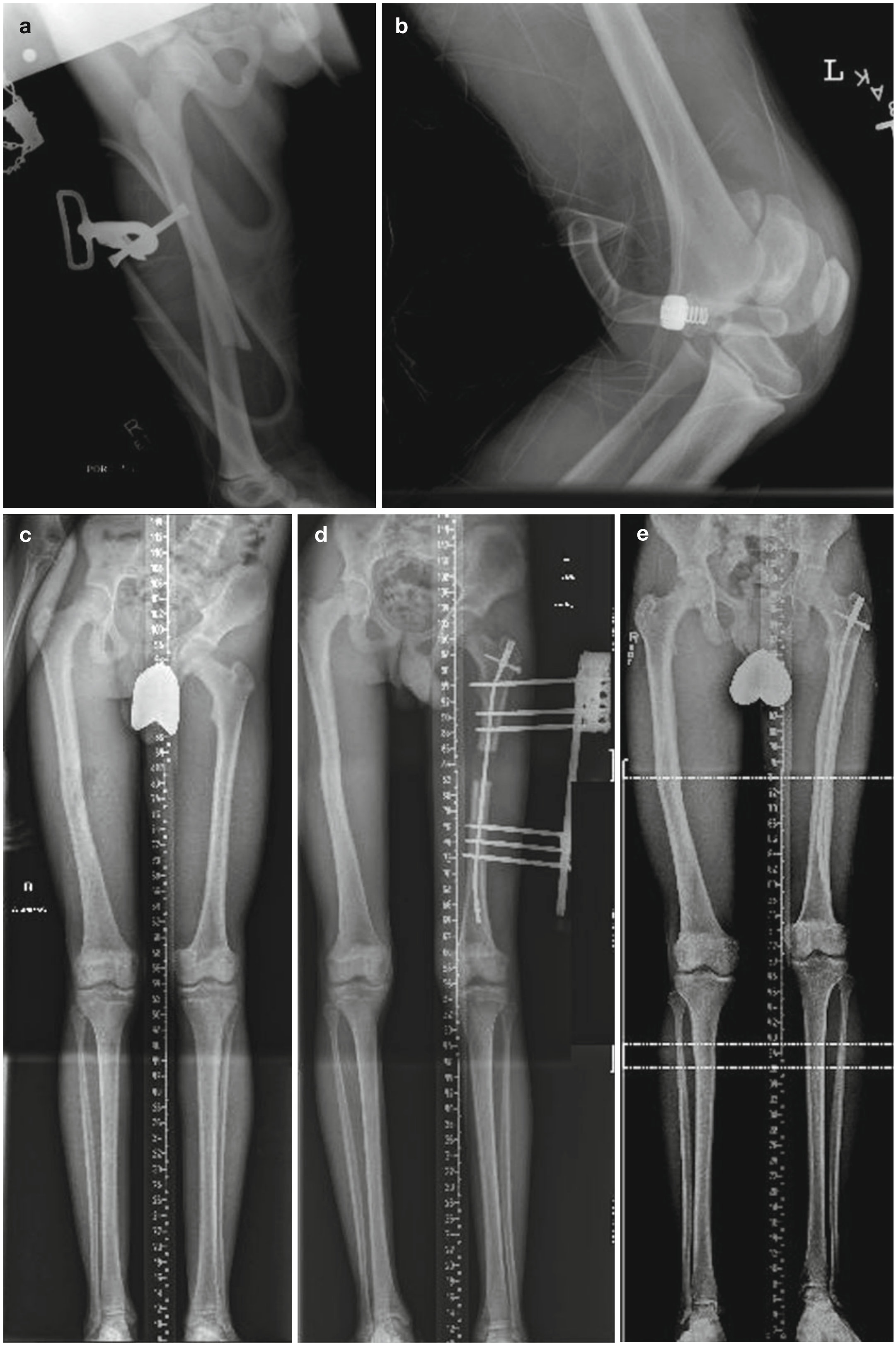

Fig. 19.2 A 9 years 10 months old male polytrauma victim who illustrates dramatic leg length discrepancy following growth arrest of left distal femoral physis (and later surgical equalization). (**a**) Injury radiograph showing right femoral shaft fracture. (**b**) Injury radiograph showing left distal femoral growth plate fracture. (**c**) Five year follow-up radiograph demonstrates 7 cm leg length discrepancy. (**d**) Lengthening left femur using monolateral external fixator and an intramedullary rod. (**e**) Two years post-op following lengthening

demonstrated favorable results with operative treatment of unstable pediatric pelvic fractures [52, 53]. Benefits include more rapid patient mobilization (through cast minimization) and normalization of pelvic bony anatomy (Fig. 19.3). Approximately 20 % of pediatric pelvic fracture patients will suffer long-term sequale such as growth abnormalities and difficulties with continence [54].

Urgent issues relative to pediatric hip and pelvic trauma include timely reduction of hip dislocations. Traumatic hip dislocations whose reduction is delayed greater than 6 h have been shown to have a 20 times higher risk of the potentially devastating complication called femoral head avascular necrosis [55]. This complication may not manifest itself until almost 1 year following injury. Late treatment issues include verification of proper pelvic growth via follow-up pelvic radiographs. Complications such as growth arrest of the triradiate cartilage (growth plate of the acetabulum) have been reported following such pelvic trauma [56–58]. Femoral neck fractures also may carry substantial risk of femoral head avascular necrosis in excess of 40 %. Older children and those with fracture patterns closer to the proximal femoral growth plate have been shown to be at higher risk. Based on the stability of the patient, rapid reduction and internal fixation is indicated for displaced femoral neck fractures.

Injuries to the Spinal Column

Few if any individuals have difficulty recognizing the gravity of phrases such as *She has broken her neck* or *His back is broken*. Based on national inpatient data, pediatric vertebral fractures are only the fifth most common orthopaedic injury, but they are associated with the highest mortality rates, the longest lengths of stay, and the highest total cost of care [35]. Isolated as well as multiple level bony or soft-tissue injury may occur in children [32, 59, 60], thus radiographic screening of the entire spine is often indicated. Motor vehicle related spine injuries predominate in the pediatric critical care setting [61, 62]. Important differences distinguish both the evaluation and treatment of pediatric spinal injuries from those of adults [63, 64]. Special attention has recently been paid to clinical clearance of the cervical spine in blunt trauma victims younger than 3 years of age [65]. Pediatric trauma surgeons from 22 institutions studied their combined trauma registry data and found four specific predictors with an accompanying weighted score of less than 2 identified children eligible for clinical clearance only (negative predictive value of 99.93 %) (Table 19.1).

An important clue to recognizing pediatric thoracolumbar vertebral fractures is the so called seat-belt sign. This ecchymotic stripe across the patient's abdomen occurs in the setting of isolated lap belt use and is most commonly associated with a pediatric Chance fracture (flexion-distraction injury usually at or near the thoracolumbar junction) [66]. A shoulder strap version of the seat-belt sign (in the region of the neck and clavicle) is also considered by some authors to indicate pediatric cervical spine fractures (Fig. 19.4) [67]. Special emergency transport measures are necessary when cervical spine injury is present or suspected in children less than 7 years of age. Herzenberg and his coauthors found that due to their disproportionately large heads, inappropriate cervical alignment was fostered when children were immobilized on standard adult-type backboards [68]. This pitfall can be avoided through the use of properly modified pediatric backboards (with a built-in recess for the head) or by elevating the remainder of the child's body with folded sheets or similar materials.

Another important difference between children and adults is the much higher likelihood of spinal cord injury without radiographic abnormality (SCIWORA) [69], which occurs in up to 38 % of all pediatric cervical spine injuries [62]. This injury pattern was recognized and the SCIWORA acronym coined in 1982 by Pang and Wilberger [70]. Magnetic resonance imaging classification of these injuries has been shown to be highly predictive of patient outcomes (Table 19.2) [71]. Modern treatment approaches to these children are associated with high rates of partial or complete neurologic recovery [72, 73] and high rates of successful non-operative (closed treatment/ external immobilization) treatment [74, 75]. When closed treatment efforts include halo-vest immobilization it must be remembered that children less than 2 years of age have less reliable bony purchase in their skulls and should receive a greater number of points of cranial fixation (usually 8–10 pins) [76]. Plain old spinal cord injury WITH radiographic abnormality is the more common circumstance, and surgical stabilization figures prominently in the treatment plan of children who survive these devastating injuries (Fig. 19.5).

Thoracolumbar injuries in children deserve additional discussion. Their association with intra-abdominal injuries must not be forgotten and proper multidisciplinary trauma evaluation is always appropriate [33]. These fractures may be divided into three simple groups: simple compression fractures (anterior wedging only with full maintenance of posterior vertebral body height), burst fractures (with compromise of posterior vertebral body height, varying degrees of retropulsion of fragments into the canal, and pedicle widening on AP radiograph), and flexion distraction injuries whose plane of disruption may be predominantly through the vertebral segment (the so-called Chance fracture) or through a varying degree of the periosteal sleeve/fibrocartilaginous boundaries of the vertebral segment. Simple compression fractures have been shown to have great potential for both healing and substantial remodeling when treated nonoperatively. Periosteal sleeve and fibrocartilaginous plane injuries have been nicely outlined by Paul Sponseller and they have

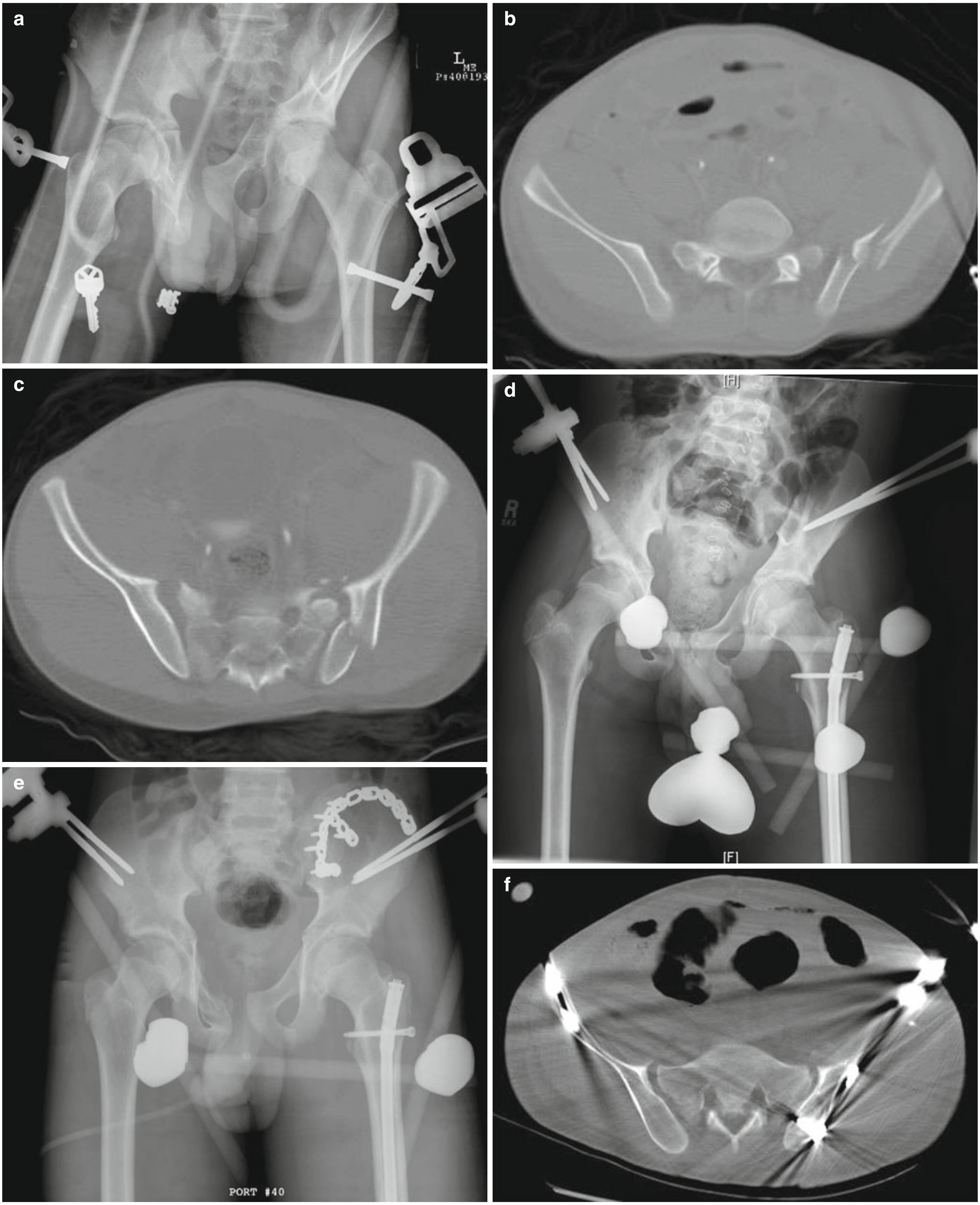

Fig. 19.3 Hemodynamically unstable 15-year-old male multiple trauma victim whose injuries included pelvic and acetabular injuries. (**a**) Initial injury AP pelvic radiograph demonstrating fracture dislocation of left sacroiliac joint as well as left ischial and acetabular fractures. (**b**) Computed tomography image demonstrating comminuted fracture of left ilem. (**c**) Computed tomography image demonstrating left sacroiliac joint involvement – this may be referred to as a pediatric crescent fracture. (**d**) AP pelvic radiograph 72 h later illustrating multiple procedures have been performed (emergently applied pelvic external fixator, emergent laparotomy, and locked intramedullary nail fixation of left femoral shaft fracture). (**e**) AP pelvic radiograph 12 days later following open reduction and internal fixation of left sacroiliac fracture-dislocation. (**f**) Post-operative computed tomography image demonstrating anatomic posterior reconstruction

Table 19.1 American Association for the Surgery of Trauma Clinical Clearance Scoring System for blunt trauma patients younger than 3 years of age

Variable	Points
GCS <14	3 pts
GCS_{EYE}=1	2 pts
MVC	2 pts
24-36 m/o	1 pt

Max score = 8 pts

Score <2 identifies pt eligible for clinical clearance only

a higher likelihood of successful nonoperative treatment due to the favorable healing potential of these tissues (as opposed to what is considered the less reliable healing of ligamentous tissue) [52]. Based on two recently published large series, the majority (60 %, 75/126) of these pediatric thoracolumbar fractures continue to be successfully treated via nonoperative methods [77, 78]. Figure 19.6 illustrates a striking example where surgery was necessary for a flexion distraction injury to the thoracolumbar spine with true fracture dislocation and complete permanent spinal cord injury.

Fig. 19.4 Shoulder and Lap Seat-Belt Signs in a 5 years old female who suffered a Pediatric Chance fracture. (**a**) Clinical photograph showing ecchymotic stripe along lower abdomen – this is the seat-belt sign (she also had a shoulder harness on, which left a mark on her neck, but there was no cervical injury). (**b**) AP radiograph of thoracolumbar spine demonstrating classic transverse plane pedicle fractures of a pediatric Chance fracture (L-2 in this case). The IVP was normal. (**c**) Lateral radiograph of thoracolumbar spine demonstrating displaced L-2 pediatric flexion-distraction Chance fracture (note marked angulation between bodies of L-1 and L-2). (**d**) Clinical photograph demonstrating kyphotic deformity localized to the thoracolumbar junction. Note the residual of the betadine prep following the bowel repair

Table 19.2 MRI classification of SCIWORA

Class 1	Complete transection	All fail to recover
Class 2	Major hemorrhage	All fail to recover
Class 3	Minor hemorrhage	40 % improve to mild
Class 4	Edema only	70 % improve to mild, 25 % normal
Class 5	Normal	All make complete recovery

Adapted from Pang [71]. With permission from Wolters Kluwer Health

Compartment Syndrome

Compartment syndrome represents a limb-threatening pediatric orthopaedic emergency in which adequate tissue perfusion is compromised by local pressure differentials. Failure to recognize and treat it in a timely fashion may result in a withered and useless limb (Volkmann's ischemic contracture) or in rare cases even necessitate amputation. Compartment

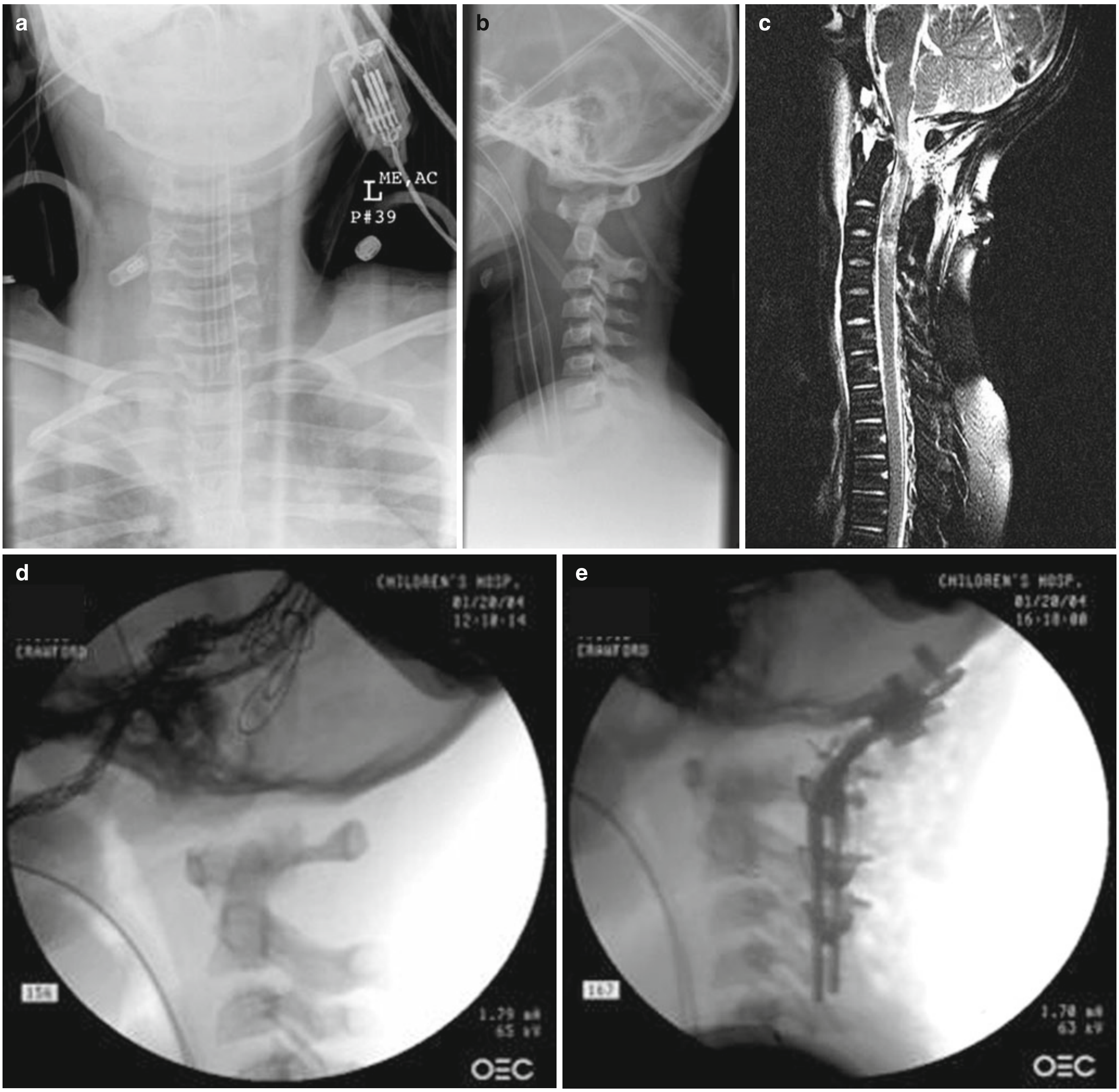

Fig. 19.5 A 9-year-old female MVA victim with occipito-atlanto, axial dissociation. She was quadriplegic on admission. (**a**) AP cervical spine radiograph. (**b**) lateral cervical spine radiograph showing C1–C2 dissociation and posterior displacement of the dens. (**c**) T-2 weighted sagittal MRI demonstrating spinal cord transection and significant soft tissue (ligamentum nuchal injury. The injury is below the ring of C1). (**d**) Fluoroscopic lateral c-spine image at the time of halo- assisted reduction. (**e**) Fluoroscopic lateral c-spine image demonstrating restoration of occipitocervical alignment with stable internal fixation. (**f**) Post-operative lateral cervical spine radiograph taken in halo-brace

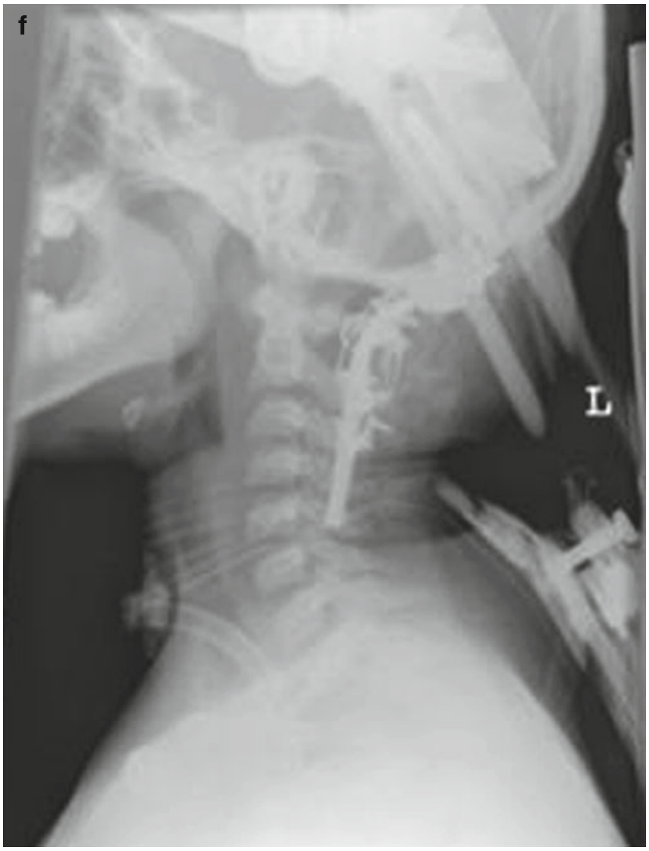

Fig. 19.5 (continued)

syndrome in children most commonly occurs in the setting of tibial shaft fractures (either open or closed) followed by forearm and elbow fractures [79–81]. A high index of clinical suspicion must be maintained in these instances. Pain out of proportion to the injury is the most important finding in alert communicative patients, but when dealing with tracheally intubated or obtunded patients the only clue may be tense compartments on physical examination. Increasing analgesia requirements in a child with an extremity injury has been suggested as a particularly important early sign of impending pediatric compartment syndrome (preceding other later findings by more than 6 h) [82, 83]. Special concern must also be exercised in a child who has suffered peripheral nerve injury as they may be deceptively comfortable despite a full-fledged compartment syndrome.

Three additional situations that may be encountered in the PICU also bear special mention. An increasing number of hand compartment syndromes have been reported secondary to intravenous fluid infiltration into subcutaneous tissue [84, 85]. The reported cases have several recurring features: younger patients (often less than 1 year of age), presence in an intensive care unit setting when the complication occurred, and normal intravenous pump alarms failed to function properly. Another special situation is that of the PICU patient who is receiving epidural analgesia. Efforts should be taken to avoid dense motor and sensory blockade in order NOT to mask an important early sign of compartment syndrome: pain out of

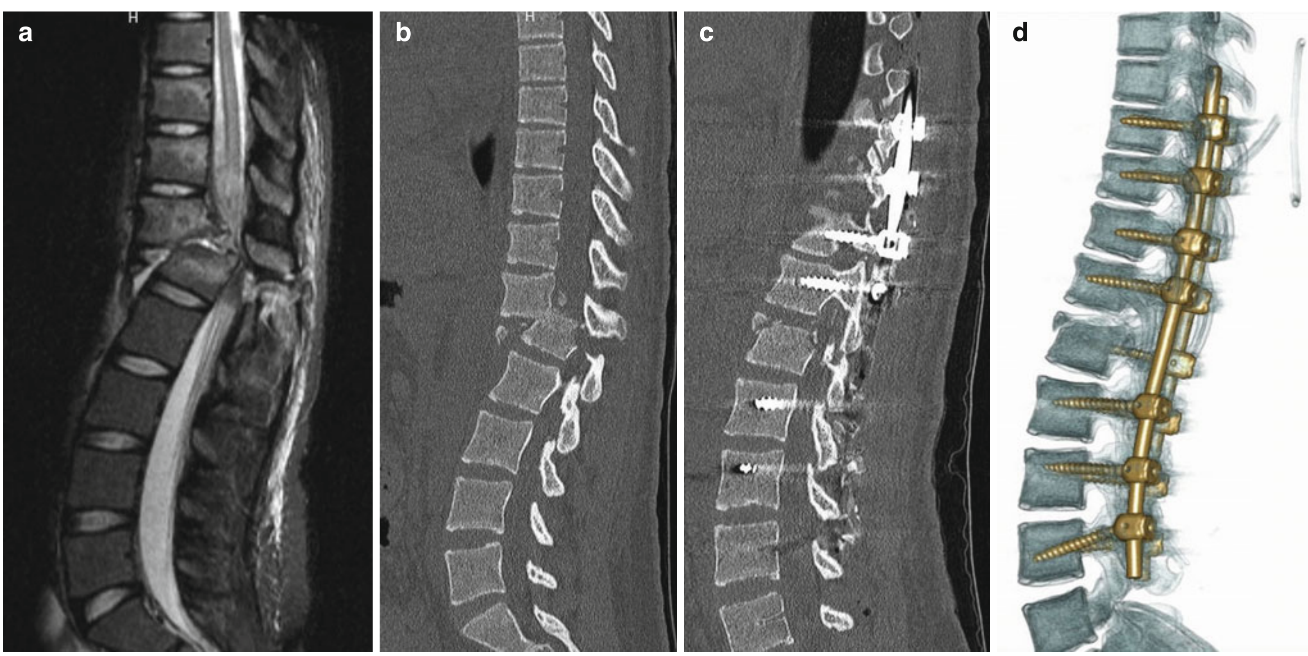

Fig. 19.6 A 14-year-old female victim of an ATV accident. (**a**) Pre-op MRI. (**b**) Pre-op CT. (**c**) Post-op CT. (**d**) Post-op 3-D CT (Case courtesy of Eric J. Wall, MD)

Table 19.3 Gustilo open fracture classification

Type I	Small relatively clean open wound less than 1 cm in size (often due to an "inside out" protrusion of the bone through the soft tissue envelope)
Type II	Larger wound usually between 1 cm and perhaps 10 cm (extensive deep soft tissue damage is not present)
Type III	These injuries have larger overall wounds and a greater degree of devitalized tissue and are subdivided into A, B, C…
A	Wound usually greater than 10 cm – but with sufficient preservation of local tissue (including periosteum) that flap coverage in not necessary
B	Classic type III wound size but with additional periosteal stripping/devitalization such that flap coverage is usually necessary
C	Classic type III wound size plus major vascular injury that requires repair in an effort to salvage the limb

proportion to the injury [86]. Finally, compartment syndrome concern exists regarding the increased use of peripheral nerve and regional blocks in children. Instances of compartment syndrome following such nerve blocks used in trauma surgery and elective surgery have been reported in adults [87, 88].

Clinical suspicion alone may be enough for experienced pediatric orthopaedic traumatologists to perform appropriate compartment releases (fasciotomies). In other instances the clinical decision making process is greatly facilitated by formal compartment pressure measurement using either commercially available devices or comparable pressure measurement tactics. Two compartment syndrome decision-making philosophies may be encountered in clinical practice. One commonly accepted practice is that compartment pressures in the 30–45 mmHg represent absolute values that will trigger surgical compartment release. The other occurs when the relative difference between compartment pressure and diastolic pressure is less than 30 mmHg. Thus with the second philosophy (interpretation within the context of the patient's blood pressure) the threshold for compartment release may be somewhat higher in a normotensive patient and significantly lower in a hypotensive patient.

Open Fractures

In the PICU, open fractures (referred to as compound fractures in the past) may range from subtle to grotesque. What they all have in common is that fracture hematoma communicates with the outside world. In one large series the two most common types of pediatric open fractures were the forearm and tibia [89]. The principles of open fracture management focus on irrigation and debridement (often serially) until only viable tissue remains. Modern pediatric internal fixation techniques have largely replaced the external fixators of yesteryear [90]. The Gustilo classification has stood the test of time with respect to usefully segregating open fractures into clinically meaningful groups (Table 19.3). Classic orthopaedic teaching has stated that all open fractures require surgical treatment within 6 h or less following injury. More recent data has challenged this contention in that no increased risk of open fracture complications was found in the setting of pediatric Type I and II injuries treated within 24 h of injury [91, 92]. Type III injuries were poorly represented in these studies and thus traditional urgent irrigation and debridement protocols are considered most appropriate.

Orthovascular Trauma

Displaced fractures may also be associated with vascular injury that threatens limb viability. The amazing thing is not that this occurs, rather that this does not occur more often. Fractures adjacent to major arterial branching areas seem to be at greater risk, as large National Trauma Databank information indicates that the most common pediatric vascular injury of the upper extremity is the brachial artery (22 % of cases, 148/684) and the most common vessels of the pediatric lower extremity to be injured involve the popliteal vasculature (11 % of cases, 73/684) [93]. The majority of these arterial injuries occur in conjunction with adjacent displaced fractures. Up to 10 % of such pediatric vascular injury patients may end up with an amputation [94]. It is also clear that individual institutional experience with such vascular injuries is rare (even at busy tertiary pediatric trauma centers). Multidisciplinary protocols (reviewed and approved by appropriate stakeholders) are thus indicated in order to optimize outcomes for such "rare event-high potential for morbidity" scenarios [94].

Absent distal extremity pulses (defined as medical personnel cannot palpate a pulse) are simply not normal [95]. Capillary refill may seem to be well-maintained, but a nonpalpable distal pulse means that the patient has an abnormal vascular examination. Supracondylar humeral fractures are the most common pediatric elbow fracture, and approximately 10–15 % of the time they present without a palpable radial pulse. Following reduction and internal fixation, close to half of patients will remain pulseless and greater than 70 % of those patients have been shown to have true arterial injury [96]. Vasospasm may be the explanation for such abnormal vascular examinations, but this is true in the minority of cases (most commonly vasospasm afflicts those less than 10 years of age) [97]. Patients with abnormal vascular examinations deserve aggressive evaluation and surgical intervention as indicated. Doppler duplex imaging of suspected vascular trauma is a well established tool that has demonstrated both sensitivity and specificity of 95 % or greater [98], and surgical exploration and repair is indicated if inadequate distal perfusion is identified.

Clavicle Shaft Fractures and Rib Fractures

Within recent years clavicle shaft fracture care has experienced a true sea change in the orthopaedic world. Based on a reasonably large randomized clinical trial conducted by the Canadian Orthopaedic Trauma Society, lower non-union rates and improved upper extremity function were demonstrated in adults whose clavicle shaft fractures were treated with plate and screw fixation [99]. No similar Level I pediatric data exist, but certain Level III and IV data has shown that clavicle shaft surgery can be performed reasonably safely [100] and functional outcomes may be achieved 4 weeks sooner with surgery as compared to nonoperative treatment. It has also been shown that the vast majority of clavicle growth has been completed by 9 years of age in girls and 12 years of age in boys [101]. All of this information needs to be taken into consideration along with the accepted trauma principles of fracture stabilization to aid patient management and rehabilitation when contemplating the relative risks and benefits of clavicle surgery.

Another provocative trauma topic has been that of surgical stabilization of rib fractures. Indications for operative management of adult rib fractures have evolved and include: flail chest (usually defined a unilateral fracture of four consecutive ribs), open fractures, and to decrease acute pain and disability [102]. A growing number of adult series have documented both short-term (shorter required period of ventilator support) and long-term (better pulmonary function at 6 months) outcomes following surgical stabilization of rib fractures [103, 104]. A recent prospective series has also confirmed lower pain levels in operatively treated adult patients [105]. The risk of pediatric mortality has been shown to be directly proportional to the number of rib fractures a child suffers [106]. The potential role for surgical stabilization of rib fractures would appear to be in the setting of older adolescents and teenagers.

Conclusion

These trauma patients will continue to challenge both the pediatric critical care intensivist and the pediatric orthopaedic traumatologist for the foreseeable future. At some future date perhaps a combination of injury prevention programs, legislation, and law enforcement will threaten the job security of those who care for such pediatric trauma victims. Until that time we must continue to refine the systems we have designed to care for these children. We are not doing such a bad job so far, as the positive impact of pediatric trauma centers is hard to deny [107, 108]. We must also continue to care for these children in a holistic fashion, demonstrating appropriate knowledge of, respect for, and coordination of the skills offered by the various disciplines poised to lend their aid.

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