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Appendix

Pediatric Orthopaedic Surgery – Adapted Complications Classification System

Grading of Complications Case Scenarios

Please grade the following case scenarios using the classification system provided in the Table below.

TABLE E-1 Classification of Pediatric Orthopaedic Surgery Complications*

Grade	Definition	Examples
I	A complication that does not result in deviation from routine follow-up in the postoperative period and has minimal clinical relevance and requires minimal treatment (e.g., antiemetics, antipyretics, analgesics, diuretics, electrolytes, antibiotics, and physiotherapy) or no treatment	Postoperative fever, nausea, constipation, uncomplicated urinary tract infection, asymptomatic Grade-I or II heterotopic ossification, wound issue not requiring a change in postoperative care
II	A deviation from the normal postoperative course (including unplanned clinic/office visits) that requires outpatient treatment, either pharmacological or close monitoring as an outpatient	Superficial wound infection (additional clinic visits), transient neurapraxia from positioning or surgical retraction that resolves under observation, delayed union, nerve palsy requiring bracing and close observation, deep-vein thrombosis requiring outpatient anticoagulation that resolves entirely
III	A complication that is treatable but requires surgical, endoscopic, or interventional radiology procedure(s), or an unplanned hospital readmission	Nonunion, postoperative fracture treatable with surgery, deep infection treatable with IV antibiotics, surgical hematoma requiring drainage or debridement, heterotopic ossification requiring surgical excision
IVa	A complication that is life or limb-threatening, and/or requires ICU admission, a complication with potential for permanent disability but treatable, a complication that may require organ/joint resection/replacement. No long-term disability	Permanent nerve injury treatable with tendon transfers, pulmonary embolus requiring ICU admission with full recovery, compartment syndrome treatable with fasciotomy, brain hemorrhage with temporary hemiplegia, renal failure requiring temporary dialysis, ICU admission for fat embolism with no long-term disability. No long-term disability
IVb	A complication that is life or limb-threatening, and/or requires ICU admission, a complication that is not treatable, a complication that requires organ/joint resection/replacement or salvage surgery. With long-term disability	Osteonecrosis requiring hip replacement, permanent nerve injury with foot drop requiring long-term bracing, major vascular injury requiring amputation, brain hemorrhage with resultant permanent hemiplegia, kidney failure requiring permanent dialysis. With long-term disability
V	Death	

*IV = intravenous, and ICU = intensive care unit.

1. 16 F with adolescent idiopathic scoliosis underwent posterior instrumentation and fusion. She did not receive thromboprophylaxis. She was found unresponsive in her bed on POD 5 and could not be resuscitated. An autopsy revealed the presence of a PE and DVT.

   Grade: _____

2. 17 F had a left PAO for a diagnosis of symptomatic left hip DDH. She had significant postoperative left hip pain, requiring prolonged PCA use and acute pain service involvement, multi-modal therapy, multidisciplinary management resulting in prolonged inpatient stay (>5 days more than routine). Pain was successfully managed as an inpatient and she had routine outpatient follow-up with normal healing and normal function.

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Grade: _____

3. 2 M had a posterior medial release for a late presenting clubfoot. At 2 weeks postoperatively, when the cast was removed, he was noted to have blistering and delayed wound-healing. He subsequently received daily home care wound care for 4 weeks and weekly clinic follow up. At 6 weeks postoperatively, the wound was completely healed. He was fitted with AFOs and started physical therapy with normal clinical course.

   Grade: _____

4. 12 M with OI type IV underwent L femoral osteotomies and insertion of a Fassier-Duval telescoping rod. On POD 2, he developed a productive cough. He was diagnosed with pneumonia and was started on IV antibiotics and then switched to oral antibiotics. He was discharged home on postoperative day 10, at which time the pneumonia had resolved and he had completed his antibiotic course. He had standard outpatient orthopaedic follow-up.

   Grade: _____

5. 10 M with type-I OI had Fassier Duval (FD) telescoping rod insertion in the right femur with femoral osteotomy for deformity correction. The patient was noted to have proximal migration of the femoral rod at 3 months postoperatively. He returned to OR for revision of the FD rod. At 1 year postoperatively, he was doing well clinically and radiographically with good position and telescoping of the FD rods.

   Grade: _____

6. 12 M with cerebral palsy, GMFCS III, sustained a subtrochanteric femur fracture and underwent open reduction internal fixation with a submuscular plate extending to the mid-shaft. At 6 weeks postoperatively, his parents were moving him from bed to chair when he had pain and swelling to the thigh. He was found to have a mid-shaft femur fracture just below the plate. He underwent open reduction and internal fixation of the distal femur with a long plate spanning the entire length of the femur, via a submuscular approach. He required ICU admission for hemodynamic monitoring postoperatively due to significant blood loss requiring intraoperative and postoperative transfusions. At 6 months postoperatively, has returned to his preoperative level of function.

   Grade: _____

7. 16 F underwent a left hip PAO for symptomatic hip dysplasia. At her 6-month follow-up, she was noted to have Grade-I heterotopic ossification on radiographs. She was asymptomatic and had no functional limitations. No treatment was required.

   Grade: _____

8. 17 M with genu varum, had a tibial osteotomy and circular external fixator for gradual correction of his deformity. He had 3 episodes of superficial pin-site infections requiring

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postoperative Keflex with close outpatient follow-up. All pin sites healed completely with no signs of superficial or deep infection and complete healing of his osteotomy site.

Grade: _____

9. 16 F who underwent posterior instrumentation and fusion for correction of adolescent idiopathic scoliosis experienced postoperative ileus, with mild abdominal distension and discomfort and nausea, requiring motility agents, and increased postoperative stay (> 2 days vs. routine). The ileus resolved, and she was discharged home on postoperative day 10.

   Grade: _____

10. 17 M had ORIF of a displaced distal clavicle fracture. Fixation included a plate spanning the acromioclavicular joint. At 1-month follow-up, pull-out of distal screw from the acromion was seen on radiographs. He underwent removal of the superior plate and screw at 6 weeks after a CT demonstrated adequate healing. He went on to have complete healing and normal function.

    Grade: _____

11. 18 F underwent closed femoral shortening for a residual leg-length discrepancy. Later in the day, she developed rapid shortness of breath and acute desaturation and became unresponsive. She was transferred urgently to the ICU but could not be resuscitated. The family declined autopsy, and it was thought that she may have had a fat embolism.

    Grade: _____

12. 12 F had an ORIF of a displaced medial epicondyle fracture with a bicortical screw. Postoperatively, she was noted to have a motor and sensory deficit of the radial nerve. She required frequent PT/OT visits and clinical follow-up and splinting to prevent contracture. She was noted to have improvement in sensation at 5 weeks, improved motor function at 3 months, with full return of motor and sensory function at 1 year.

    Grade: _____

13. 18 M had a foot drop that did not resolve following a PAO. He underwent a tibialis posterior transfer 1 year following PAO. At 3 months following tibialis posterior transfer, he had active dorsiflexion beyond neutral and did not require an AFO. He had a normal functional outcome.

    Grade: _____

14. 8 F with CP, GMFCS IV underwent bilateral proximal femoral VDROs for progressive hip subluxation. On POD 3, she developed a fever, which was secondary to a UTI. She was treated with oral antibiotics during her inpatient stay. Her fever and UTI resolved and she was discharged home on POD 7, with standard outpatient follow-up.

    Grade: _____

15. 14 M with a bimalleolar ankle fracture presented with a peroneal nerve palsy on POD 1 following ORIF. He had decreased sensation over the dorsal and plantar aspects of the left

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foot and grade-1 left ankle dorsiflexion and toe extension. The neurapraxia was thought to be secondary to peripheral nerve block. He was referred to neurology, and the diagnosis of a neurapraxia was confirmed. He was started on Lyrica at 13 days postoperatively. At 4 weeks postoperatively had improved motor weakness: Grade 4/5 dorsiflexion and grade 3/5 toe extension. At that time, sensation had returned to the dorsum and plantar foot, although he reported burning pain at night. At 1 year, neurapraxia had completely resolved.

Grade: _____

16. 6 F underwent pinning of a type-III supracondylar right distal humeral fracture. She developed a septic arthritis of the right elbow 1 week postoperatively, with cultures showing growth of *E. coli*. She returned to the OR multiple times for irrigation and debridement. The infection was cleared, but 1 year following the last debridement, she continues to have limited range of motion of the right elbow.

    Grade: _____

17. 6 F with neuromuscular scoliosis had subcutaneous dual growing rods placed. She was noted to have superficial wound infection secondary to a stitch abscess 2 weeks postoperatively and was treated with oral antibiotics. The superficial wound infection resolved with 2 weeks of antibiotic treatment and wound care.

    Grade: _____

18. 9 M developed AVN of the left lateral condyle 6 months following ORIF of the left lateral condyle. He continues to have pain and limited range of motion at 1 year postoperatively.

    Grade: _____

19. 14 M post ORIF of a left triplane fracture had wound dehiscence at 2 weeks postoperatively requiring 5 additional intraoperative procedures, including irrigation and debridement, negative pressure dressing, and a free flap, which failed secondary to deep infection. He acutely became hemodynamically unstable following admission for planned I & D of the free flap. He returned to the OR emergently for suspected necrotizing fasciitis. He required postoperative ICU admission for hemodynamic monitoring and resuscitation. He went on to heal via secondary intention with the VAC dressing and, at 6 months postoperatively, had a completely healed incision with no functional limitations.

    Grade: _____

20. 12 M underwent intramedullary reduction and fixation of a radial neck fracture and subsequently developed AVN causing pain, stiffness, and functional limitations. He then underwent radial head resection and radial head arthroplasty at skeletal maturity. He continues to have some functional limitations.

    Grade: _____

21. 12 M underwent flexible IM nailing of a midshaft right radius and ulna fracture. At 6 weeks, he noted a sudden loss of right thumb extension. Clinical exam and an US confirmed a ruptured extensor pollicis longus tendon. He returned to OR for nail removal and direct

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repair of EPL tendon by the hand team. He has not achieved full motor strength of thumb extension on his dominant hand, which interferes with activities of daily living.

Grade: _____

22. Healthy 14 F with adolescent idiopathic scoliosis underwent PSIF and experienced postoperative abdominal distension. Gastric perforation was confirmed by CT on postoperative day 4. She required emergent return to the OR for exploratory laparotomy and primary gastric repair and a wound VAC was placed. She had a postoperative ICU stay, during which a NJ tube was placed until she was tolerating oral feeds. She was discharged home with an abdominal wound VAC, 4 weeks post PSIF. She required both general surgery, GI and orthopaedic follow-up. She returned to a normal diet and regained full pain-free function.

    Grade: _____

23. 17 F underwent a surgical hip dislocation and femoral neck osteochondroplasty for FAI. At 6 months postoperatively, she had persistent symptomatic nonunion of the greater trochanteric osteotomy site, seen on both x-ray and CT scan. Infection was excluded. She underwent a revision open reduction internal fixation of the greater trochanter with bone graft and a trochanteric plate. At 3 months following revision ORIF, she had radiographic union of the greater trochanter and was asymptomatic.

    Grade: _____

24. 15 M with kyphoscoliosis and NF-1 underwent posterior instrumentation and fusion for correction of his thoracic spinal deformity. He was noted to have a dense paraplegia postoperatively, with no hardware malposition, with minimal recovery of motor and sensory function in both lower extremities.

    Grade: _____

25. 8 F had signs and symptoms of an ulnar nerve neurapraxia following crossed pinning for a Type III supracondylar fracture. The medial pin was immediately removed in the PACU. She received physical therapy and splinting to maintain range of motion and to avoid contractures. She also had a referral to the hand team. She had frequent outpatient follow-up. At 2 months, her neurapraxia had resolved.

    Grade: _____

26. 12 F with neuromuscular scoliosis, with significant comorbidities and a high ASA underwent PSIF. She died during the first week of her inpatient stay due to an unknown cause.

    Grade: _____

27. 12 M with cerebral palsy and spastic diplegia underwent bilateral distal femoral extension osteotomies and patellar tendon advancements. He had decreased sensation immediately postoperatively over the dorsal and plantar aspects of the left foot. The knee immobilizer was

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removed, and the knee was flexed to take tension off of the sciatic nerve. The neurapraxia resolved prior to discharge and the remaining clinical course was normal.

Grade: _____

28. 9 M underwent flexible nailing of a length-stable midshaft femoral fracture. At the 6-month visit, he was noted to have delayed union of the fracture site, with acceptable alignment maintained, on radiographs. Infection was ruled out. He was prescribed a bone stimulator and had fracture union, both clinically and radiographically, at 9 months.

Grade: _____

29. 13 M who underwent bilateral flatfoot reconstruction experienced severe postoperative nausea and vomiting, with no signs or symptoms of bowel obstruction. He was treated with IV antiemetics, resulting in a longer-than-expected postoperative stay (>2 days more than routine). The nausea and vomiting resolved prior to discharge, and he had normal healing and functional outcomes.

Grade: _____

30. 15 F with AIS underwent PSIF. On postoperative day 2, she had moderate sanguineous drainage from the incision and a fluctuant mass was palpated. She remained afebrile. An ultrasound demonstrated a large subcutaneous fluid collection consistent with a hematoma. She returned to the OR for evacuation of a subcutaneous hematoma. Cultures of intraoperative specimens were negative. The patient was discharged home 10 days following the index surgery and had a normal postoperative course.

Grade: _____

31. 12 M with cerebral palsy (GMFCS V) underwent bilateral proximal varus derotation osteotomy, rectus femoris transfer and medial hamstring lengthening, and distal tibial derotation osteotomy. He experienced nausea and vomiting on POD 1 and developed a productive cough on POD 2. He was found unresponsive on POD 3 and could not be resuscitated. Autopsy revealed aspiration pneumonia, likely leading to respiratory collapse.

Grade: _____

32. 10 F with cerebral palsy and spastic diplegia underwent bilateral distal femoral extension osteotomy and patellar tendon advancement. A significant extensor lag was unilaterally noted at the second postoperative visit. She was treated with a long-leg cast for 4 weeks, followed by intensive physical therapy, including gait training with ground-reaction AFOs. She continued to have a persistent significant lag and underwent a patellar tendon retensioning in the OR 6 months following the initial surgery. At 3 months following the patellar tendon retensioning, she had no extensor lag and was ambulating well.

Grade: _____

33. 16 M underwent an ACL reconstruction. Intraoperatively, he developed signs and symptoms consistent with malignant hyperthermia and could not be adequately resuscitated. He died intraoperatively.

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Grade: _____

34. 16 M underwent a left ACL reconstruction. He developed a symptomatic left lower leg DVT at 10 days postoperatively, which was treated with Coumadin. He was followed by the thrombosis team as an outpatient. At the 6-month postoperative visit, he had achieved his rehabilitation milestones and had completed Coumadin treatment.

    Grade: _____

35. 18 F who underwent periacetabular osteotomy was noted to have immediate postoperative common peroneal nerve motor and sensory deficit. She had only partial recovery at 1 year and wears an AFO.

    Grade: _____

36. 14 M presented with emesis and circulatory collapse 40 days after insertion of Harrington rods and casting for scoliosis correction. He was diagnosed with SMA syndrome. He had total gastrectomy and esophagojejunal anastomosis. He experienced a cardiac arrest immediately postoperatively, leading to death.

    Grade: _____

37. 10 M with Type-III OI underwent L femur osteotomies and insertion of telescoping intramedullary nails. He had 3 L of blood loss intraoperatively and required intraoperative transfusions. He continued to be hemodynamically unstable and was transferred to the ICU for resuscitation. He developed disseminated intravascular coagulation and required a prolonged ICU stay of 4 weeks. He was eventually transferred to the floor, where he spent an additional 4 weeks prior to being discharged home. At 6 months postoperatively, the osteotomy sites had healed and he had regained full function.

    Grade: _____

38. 14 M with neuromuscular scoliosis underwent posterior instrumentation and fusion from T2 to the pelvis, with loss of SSEP and MEP intraoperatively and a concurrent drop in systolic blood pressure. All instrumentation was removed and fluid resuscitation was initiated, including blood products. After an intraoperative neurosurgery consult, closure was undertaken. After fluid resuscitation and closure, SSEPs and MEPs fully returned. The patient remained intubated and was transferred to the ICU. An emergent MRI demonstrated no intraspinal pathology. The signal loss was likely due to inadequate intraoperative fluid management, decreasing spinal cord perfusion. Once extubated, the patient had full motor and sensory function. He returned to OR within 1 week for instrumentation and fusion. Postoperatively, he had full neurovascular function and progressed well with rehabilitation.

    Grade: _____

39. 15 M with cerebral palsy (GMFCS V) who underwent resection of the left hip (Castle procedure) for a painful chronically dislocated hip. At 2 months postoperatively, he was noted to have ongoing pain and limited ROM in the left hip and radiographs demonstrated

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Grade-III heterotopic ossification. He underwent resection of the heterotopic ossification and gained pain-free ROM of the hip.

Grade: _____

40. 16 M presented with knee stiffness following ACL reconstruction. He required manipulation intraoperatively at 3 months for arthrofibrosis. He regained motion and normal function.

Grade: _____

41. 11 F underwent intramedullary flexible nail (Metizeau technique) reduction of a radial neck fracture and closed reduction of an elbow dislocation. On POD 3, she developed compartment syndrome. She required compartment release and VAC dressing. She returned to the OR a third time for primary closure. At 2 weeks postoperatively, she had a healed incision and full neurovascular function of the hand. She went on to have complete healing with normal function.

Grade: _____

42. 12 M developed compartment syndrome of the forearm 24 hours after IM flexible nailing of a both-bone forearm fracture. He underwent emergent forearm fasciotomies that required a subsequent flap for closure. He has permanent pain and stiffness in the left hand.

Grade: _____

43. 9 M with cerebral palsy (GMFCS V), underwent a proximal femoral varus osteotomy for progressive hip subluxation. He did not receive thromboprophylaxis and had an unknown positive family history of a hereditary clotting disorder. He developed severe respiratory distress on POD 1, with investigations demonstrating a PE and DVT. He died the same day.

Grade: _____

44. 6-month-old baby underwent a closed reduction of a dislocated left hip with application of a spica cast. On POD 1, the cast was found to be prominent in both axillae, causing small skin abrasions. The cast was trimmed while in hospital, and the patient was discharged the same day. At the first postoperative visit, the abrasions had healed. She had standard outpatient follow-up.

Grade: _____

45. 14 F experienced nausea and vomiting on POD 3 following posterior spinal instrumentation and fusion for adolescent idiopathic scoliosis. She was diagnosed with SMA syndrome following a barium study. She became acutely hypotensive and required transfer to the ICU. Treatment included fluid resuscitation and NJ tube insertion for decompression, with gradual introduction of oral nutrition, starting first with fluids, then soft foods. The inpatient hospital stay was 3 weeks. Following discharge, she had outpatient GI follow-up in addition to orthopaedic follow-up. At 3 months postoperatively, she had full gastrointestinal function and was progressing well with rehabilitation.

Grade: _____

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46. 8-month M who had bilateral clubfoot deformity secondary to arthrogryposis underwent Ponseti casting and percutaneous Achilles tenotomies in the office under local anaesthetic. His parents noted bleeding through the left cast after discharge, and therefore the patient presented to the ER. US confirmed laceration of the left tibial nerve and posterior tibial artery. He required an emergent second operation for direct repair of the neurovascular bundle. At his 3-week postoperative follow-up, he had brisk capillary refill in the left foot, and, at 2 months postoperatively, he had intact motor and sensory function of his left tibial nerve and a palpable posterior tibial pulse.

    Grade: _____

47. 10 M with neuromuscular scoliosis underwent posterior instrumentation and fusion. He developed urosepsis, leading to renal failure, and septic shock. He was emergently transferred to the ICU for ongoing resuscitation. He died within 24 hours after the onset of sepsis.

    Grade: _____

48. 12 M with a displaced tibial tubercle fracture developed compartment syndrome 48 hours after ORIF. He underwent urgent lower leg fasciotomies. Postoperatively, he developed reperfusion syndrome with acute kidney failure, for which he required dialysis and an ICU stay. At 6 months postoperatively, he was able to ambulate (although with an ankle contracture) and continues to be followed by a nephrologist.

    Grade: _____