Author, Year Country Study Design Sample Size	Population Intervention Outcome Measure	Results
(Kulshrestha et al., 2020) United Kingdom Observational N=62	**Population:** Age at injury: 17 (13-17) yr; Gender: males=44, females=18; Injury etiology: traumatic=51, non-traumatic=11; Time since injury: 28 (22-33) yr. **Intervention:** None. Chart review. **Outcome Measures:** Incidence of scoliosis.	**Scoliosis** 1. At the time of discharge, 4/62 patients (6%) had developed scoliosis, increasing to 19/62 (30%) 10 yr post injury and 21/62 (34%) at the latest clinical assessment. 2. The Cobb angle could be determined for seven patients, giving a median value of 70° (21–72). 3. The overall incidence of scoliosis was smaller in the traumatic group (13/52; 25%) than in the neurological group (8/11; 72%). 4. Patients older at injury were less likely to have developed scoliosis at 10 yr (p<0.001). 5. Younger age did (p=0.001) but being non-traumatic did not (p=0.29) predict development of scoliosis.
(Mulcahey, Gaughan et al. 2013) USA Observational N=217	**Population:** Age at interview: 13.2 yr; Age at injury: 9.0 yr; Gender: males=127, females=90; Time since injury: 4.2 yr; Level of injury: tetraplegia=112, paraplegia=95; Severity of injury: complete=105, incomplete=96. **Intervention:** None. Chart review. **Outcome Measures:** International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI), Cobb angles as a measure of the prevalence of scoliosis, prevalence of spinal fusion.	**Scoliosis** 1. 78% (145/186) of subjects had >10° scoliosis, 47% (87/186) had >20° scoliosis, and 20% (37/186) had >45° scoliosis. 2. When grouped as an entire sample, age at injury (p=0.0001) and AIS classification (p=0.0095) were the only significant predictors of worse curve. 3. With the exclusion of subjects with AIS D, age at injury (p=0.0140) was the only significant predictor of worse curve. 4. Age at injury (p=0.007) was the only significant predictor of spinal fusion in the entire sample and remained as such with the exclusion of subjects with AIS D (p=0.009). 5. The risk of spinal fusion increased 11% for each year decrease in age at injury; this finding is consistent with or without inclusion of subjects with AIS D. 6. Sex, motor score, and neurological level were not predictors of worse curve or spinal fusion. 7. Of the subjects >14 yr old at the time of their evaluation and injured at <12 yr old (16/43), 13% required a spine fusion compared to 4% injured at >12 yr old (27/43). 8. Subjects injured at <12 yr old were 3.7 times more likely to require a spinal fusion than those injured at >12 yr old.
(Johnston, Betz, et al., 2009) USA RCT N=30 PEDro=2	**Population:** Age: 9.7±2.5 yr; Gender: females=13, males=17; Level of injury: C=11, T=19; Severity of injury: ASIA A=22, AIS B=5, AIS C=3. **Intervention:** Subjects were randomized to one of three groups: 1) Functional Electrical Stimulation (FES) cycling (50 rpm while seated in wheelchair, pulse duration=150 ls, frequency=33 Hz, amplitude max 140 mA, increased automatically to generate sufficient force to maintain the cadence); 2) passive leg cycling (50 rpm), or 3) non-cycling with 20 min daily surface stimulation to lower extremity muscles. Sessions were conducted for 1 hr/day, 3 days/wk for 6 mo.	**Hip Subluxation** 1. No differences in migration indices were found between baseline and 6 months (p=0.667), indicating that the intervention had no effect on these values. 2. No differences were found between groups over time (p=0.891); however, differences were found between groups (p<0.001), with the passive cycling group having greater migration indices than the FES cycling group at any time (p<0.001).

	Outcome Measures: Hip subluxation as measured by migration index of the femoral head.	
(Sison-Williamson et al., 2007) USA Observational N=20	**Population:** Age: 10.9±3.0 yr; Gender: males=10, females=10; Level of injury: cervical=1, thoracic=17, lumbar=2; Severity of injury: AIS A=18, AIS C=2. **Intervention:** Subjects were positioned on a standard chair to decrease sitting and posture differences, introduced by variations in wheelchair designs. Subjects' hips, knees, and ankles were positioned at 90°. Reflective markers were placed on the C7, sternal notch, acromion joints, olecranon, ulnar and radial styloid, and hands. Three-dimensional upper extremity motion analysis using an 8-camera Motion Analysis System was used to capture the subjects' reaches. **Outcome Measures:** Workspace volume and reach with and without a thoracic lumbar sacral orthosis (TLSO).	**Scoliosis** 1. Without the TLSO, the average reaching volume was 112,836 cm^3. 2. With the TLSO, the average reaching volume was 80,711 cm^3, which represents a 28% decrease in volume of reach (p=0.0002). 3. The largest increase in volume of reach without the TLSO was 77.3%, while the smallest increase in volume was 4.9%. 4. 10 of 39 cases had less than a 10% change between the TLSO and non-TLSO conditions, while 6 cases had increases in volume greater than 50%. 5. There were 6 cases in which volumes were larger in the TLSO condition compared with the non-TLSO condition; the percent differences ranged from 5-28%. 6. The non-TLSO average ranges of reach in the anterior-posterior (AP), medial-lateral (ML), and vertical (V) directions were 80±26 cm, 118±24 cm, and 97±21 cm, respectively. 7. The TLSO average ranges of reach in AP, ML, and V directions were 72±19 cm, 113±24 cm, and 94±21 cm, respectively. 8. The AP and ML average ranges of reach were statistically greater in the non-TLSO condition than the TLSO condition (p=0.002, p=0.01), whereas the V reach showed no significant difference. 9. When comparing non-TLSO condition to TLSO condition, the nondominant ML reach was significantly greater in the non-TLSO condition than the TLSO condition (p=0.003), while AP and V reaches showed no significant difference. 10. For the non-TLSO condition, AP reach was significantly greater than the TLSO condition (p=0.009), while ML and V reaches showed no significant difference. 11. There were no significant differences between AP, ML, and V ranges of reach when comparing nondominant and dominant arms in the non-TLSO condition. 12. In the TLSO condition, ML reach was significantly greater for the dominant arm than the nondominant arm (p<0.05).
(Chafetz et al., 2007) USA Pre-Post N=14	**Population:** Age: 10.8±2.4 yr; Gender: males=7, females=7; Level of injury: cervical=1, thoracic 1-5=3, T6-11=10. **Intervention:** Subjects completed the activities of the functional activities scale (FAS) and the timed motor test (TMT) which included 6 activities involving dressing, transfers, and wheelchair propulsion, with a thoracic lumbar sacral orthosis (TLSO) and without a TLSO. Subjects were asked their preference for wearing or not wearing the TLSO during each of the activities.	**Scoliosis** 1. For donning a shirt, there was a 26% increase in time with a TLSO compared to without a TLSO (p<0.001). 2. For donning pants, there was a 21% increase in time with a TLSO compared to without (p<0.001). 3. The time to complete increased by 42% for even transfers and 28% for uneven transfers with TLSO compared to without (p<0.001). 4. For wheelchair propulsion down a hallway, there was a 6% increase in time with a TLSO than without (p<0.001). 5. Wheelchair propulsion ascending a ramp was not significantly impacted by wearing a TLSO (p=0.11). 6. Wearing a TLSO did not impact the activities of eating, grooming, wheelchair propulsion, curb

	Outcome Measures: Functional Independence Measure (FIM), 6 wheelchair/transfer skills, Timed Motor Test (TMT), preference.	management, "popping wheelies," or transitioning from sitting at the edge of a bed to a supine position. 7. A reduction of scores was evident for dressing (upper and lower body), bladder management, bed transfers, reaching for the floor, and transitioning from a supine position to sitting at the edge of the bed, but only upper-body dressing was statistically significantly different ($p<0.01$). 8. For eating, grooming, wheelchair propulsion, and popping a wheelie, subjects did not have a preference to wear or not wear a TLSO. 9. Preference for not wearing a TLSO was significantly different ($p<0.05$) for lower-body dressing, reaching for the floor, and transitioning from a supine position to sitting at the edge of the bed.
(Mehta et al., 2004) USA Observational N=123	**Population:** Age at interview: 7.4 yr; Age at injury: 5.3 yr; Gender: males=69, females=54; Injury etiology: traumatic=115, non-traumatic=8; Level of injury: cervical=69, thoracic=54; Severity of injury: AIS A=71, AIS B=49, AIS C=1, AIS D=2. **Intervention:** None. Chart review. **Outcome Measures:** Radiographic curve severity of the spine, prevalence of bracing, surgery and cessation of growth	**Scoliosis** At follow-up (range 2-13 yr), 95% of patients had developed scoliosis; surgical stabilization was required in 65% of the total sample. **Group I (initial curve <10°; n=42)** 1. 29 of the patients in this group were braced, and 13 who were not. 2. Of the braced group, 13 (45%) went on to surgery, whereas 10 (77%) of the non-braced group had surgical correction ($p=0.03$). 3. Of the patients who were initially braced, the average time to surgery was 8.5 yr, whereas that for the non-braced group was 4.2 yr ($p=0.002$). 4. There was no significant difference between time to surgery for the braced and non-braced patient groups at higher (>20°) initial curve presentations. **Group II (Initial curve 11 ° to 20°; n=25)** 1. Eighteen (72%) patients in this group were braced and 72 8%) were not braced. 2. Nine of the 18 children in the braced group (50%) required surgery at 6.8 years after initial presentation, whereas 6 of 7 of the nonbraced group (86%) required surgery at 3.7 years after presentation. 3. The difference between the rate of surgery ($p=0.04$) and the length of time to surgery ($p=0.008$) in the braced vs nonbraced group was statistically significant, whereas the curve at the time of surgery was not ($p=0.52$). **Group III (Initial curve 21 ° to 40°; n=28)** 1. Of the 20 (61%) children initially braced in this group, 1 2 (60%) went on to have surgery at 4.2 years after presentation, whereas 8 (40'7'o) did not require surgery. 2. Of the 8 children (3 9%) who were not braced, 6 (7 5%) went on to surgical correction at 3.2 years after presentation. 3. While there was no statistical difference for time to surgery between the braced and nonbraced patients in group III ($p=0.3$ 6), there was a trend

		toward less surgical intervention in the braced patients (p=0.08). **Group IV (Initial curve > 41 ° but < 50°; n=16) & Group V (curves > 51 ° at presentation; n=12)** 1. In Group IV, one patient (6%) was not braced and proceeded to surgery, whereas 15 (94%) were braced, of which 12 (80%) went on to have surgical correction of their deformity. 2. In Group V, ten patients (83%) were braced and 2 (17%) were not braced; surgical correction of the spine was performed on 8 children (80%) in the braced group and both children (100%) in the nonbraced group. 3. In group IV and V, There was no significant difference between time to surgery for the braced and non-braced patient groups.
(Vogel et al., 2002c) *Part II* USA Observational N=216	**Population:** Age at injury: 14.1±4.0 yr; Age at interview: 28.6±3.4 yr; Gender: males=150, females=66; Time since injury: 14.2±4.6 yr; Level of injury: tetraplegia=123, paraplegia=93. Severity of injury: C1-4 ABC=41, C5-8 ABC=67, T1-S5 ABC=82, tetra/para D=26. **Intervention:** None. Survey. **Outcome Measures:** Prevalence of scoliosis.	**Scoliosis** 1. Scoliosis affected 40% of participants and was significantly associated with younger age at injury (p<0.001); prevalence of scoliosis was 86% in children injured at ≤12 yr, and 31% in those injured at older ages. 2. Subjects with scoliosis had a longer duration of injury (p<0.001) and were more likely to have had a violent etiology (p=0.003) compared to those without scoliosis. 3. Scoliosis was not associated with gender or level of injury. 4. Scoliosis more commonly affected individuals with hip subluxation or contractures compared to those without these hip complications (p=0.003). 5. Scoliosis was not statistically associated with back pain, pressure ulcers, or respiratory complications. **Hip Subluxation** 1. Hip subluxation or contractures affected 68 participants, with 18 experiencing hip subluxation alone, 33 contractures alone, and 17 with both hip contractures and subluxation. 2. Hip subluxation was significantly associated with younger age at injury and longer duration of injury (p<0.001); rates of hip subluxation were 43% (6/14) for those injured at ≤5 yr, 52% (11/21) injured at ≤8 yr, and 41% (11/27) of those injured at ≤10 yr. 3. Hip subluxation was not significantly associated with gender, neurological level, ASIA motor score, or FIM scores. 4. Hip contractures were not associated with age at injury or duration of injury or spasticity. 5. Hip contractures were significantly more prevalent in those with injuries due to violence than non-violent injuries (59% versus 20%; p<0.001) and those with paraplegia compared to those with tetraplegia (p<0.001). 6. Those with hip contractures demonstrated significantly higher total FIM (p=0.001) and motor FIM scores (p=0.002). **Fractures** 1. A total of 45 pathological fractures were experienced by 32 subjects. 2. Individuals who developed pathological fractures were significantly older at the time of interview,

		(p=0.038) had a longer duration of their SCI (p=0.011), and more likely to have lower cervical level injuries (C5-C8 A-B-C) (p=0.010). 3. There were no other significant associations between pathological fractures and the remaining study variables. **Ankle Pain and Contractures** 1. Ankle pain or contractures affected 53 subjects, with 29 individuals having contractures alone, 18 reported pain only, and 6 had complaints of both contractures and pain. 2. Ankle pain was significantly associated with older age at injury (p=0.018) and tetraplegia (p=0.005). 3. Ankle contractures were not significantly associated with any of the study variables. **Elbow Pain and Contractures** 1. Elbow pain or contractures affected 43 subjects with 27 experiencing elbow pain alone, 10 had elbow contractures alone, and 6 had both. 2. Those with elbow pain were significantly older at follow-up (p=p=0.026) and had a longer duration of their SCI (p=0.041). 6. As expected, elbow contractures were significantly more common in those with tetraplegia (p=0.040) and were significantly associated with lower ASIA motor scores (p=0.016) and lower total FIM (p=0.010) and motor FIM scores (p=0.009).
(Moynahan, Betz, et al., 1996) USA Observational N=51	**Population:** Age: 14.5±4.2 (3-20) yr; Gender: males=30, females=21; Level of injury: cervical=19, thoracic/lumbar=32. **Intervention:** Patients underwent bone density measurements using dual photon absorptiometry. **Outcome Measures:** Bone Mineral Density of femoral neck, Ward's triangle and intertrochanteric region of the hip, presence of spasticity, number of pathological fractures.	**Fractures** 1. Subjects with SCI had lower bone densities compared to their non-disabled peers, ranging from 56-65 % of normal across the three anatomic regions. 2. On average, subjects who had a previous history of fractures had significantly lower bone density measurements than those without fractures (p<0.05). 3. At the intertrochanteric region, a 10.6% difference was noted between subjects with tetraplegia versus those with paraplegia. 4. At the femoral neck and Ward's Triangle, an 8.5% difference was noted between subjects with and without spasticity.
(Dearolf et al., 1990) USA Observational N=155	**Population:** *Preadolescent Group (N=61):* Age at injury: 8.5 yr (males, N=43), 7.5 yr (females, N=18); Injury etiology: traumatic=57, non-traumatic=4; Level of injury: cervical=13, thoracic=45, lumbar=3; Severity of injury: complete=50, incomplete=11. *Post-adolescent Group (N=94):* Age at injury: 17.0 yr (males, N=68), 16.0 yr (females, N=26); Injury etiology: traumatic=94, non-traumatic=0; Level of injury: cervical=67, thoracic=23, lumbar=4. **Intervention:** None. Chart review. **Outcome Measures:** Prevalence of scoliosis.	**Scoliosis** *Preadolescent Group* 1. 55 (96.5%) of the patients that did not receive treatment developed a paralytic scoliosis. 2. Curve progression was rapid in this group; 8 (14%) of patients who were <1 year postinjury had developed curves of >20 deg; 17(31%) of patients who were <2 years post injury had developed curves of >20 deg. 3. Curve progression was 10.6 deg/year on average 4. The degree of curve that developed was not related to the level or completeness of the spinal cord injury. 5. Of the 12 patients braced and followed for an average of 48 mo, 5 progressed and either have had surgery already or planned, while 7 have progressed <5°. 2 of the braced patients developed pressure sores. 6. 19 (33%) patients required surgical intervention for a progressive paralytic scoliosis.4 of them initially underwent Luque rodding with wires without fusion; their curves progressed without

		gains in spinal height, without gains in spinal height necessitating further spinal stabilization with fusion. 7. The average prefusion curve was 52° with post-fusion correction to 25°, for an average correction of 50%. 8. Pseudarthrosis developed in 5 (26%) of the patients and 11 (58%) of the patients required reoperation. 9. Loss of correction after surgery >5° occurred in 10 patients. *Post-adolescent Group* 10. 41 (48%) of the patients that did not receive treatment developed a progressive paralytic scoliosis. 11. Curves slowly progressed to a significant degree in 15 (36%) of the patients in whom curves >20° developed >2 yr post injury. 12. Curve progression was 5.4 degrees/year, on average. 13. 13. 5 patients (5.3%) eventually required a surgery for a progressive paralytic scoliosis; the average prefusion curve was 50 degrees and the average postfusion curve was 12 degrees.