Spine Injuries Associated With Falls From Hunting Tree Stands

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ABSTRACT: Spinal injuries resulting from falls out of tree stands are often associated with concomitant neurologic deficit, prolonged hospitalization, and long-term disability. The purpose of this study was to review the types of spinal injuries that resulted from falls from hunting tree stands. We retrospectively reviewed 27 patients who came to our institution for treatment of spine injuries related to tree-stand accidents between 1981 and 1997. Eleven percent of the falls were alcohol related. Mean height of the fall was 19.6 feet (range, 10 to 35 feet). There were 17 burst fractures, 8 wedge compression fractures, 4 fractures involving the posterior elements, and 1 coronal fracture of the sacral body. Significant neurologic injury occurred in 12 patients (44%). Sixteen patients (59%) had associated injuries. Nine patients (33%) had open reduction, internal fixation, and fusion of their spine fractures. One patient was treated with a halo jacket. The remaining patients were treated in rigid, molded, polypropylene thoracolumbar orthoses or lumbosacral corsets. Accidental falls from tree stands may result in significant spinal fractures often associated with concomitant neurologic injury, extended hospitalization, and permanent disability. Many of these injuries may be prevented through aggressive hunter safety education.

Hunting is a very popular recreational activity. There are approximately 15.2 million licensed hunters in the United States[1] and approximately 150,000 licensed hunters in North Carolina.* Techniques used in big game hunting often include elevated platforms, or tree stands, built or attached to trees. These tree stands provide the

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hunter with enhanced visualization while minimizing detection by game through sight or scent, but these advantages also create a potential risk to the hunter. A fall from a tree stand can lead to serious injury. We describe 27 patients who sustained injuries to the spine after falling from tree stands.

MATERIALS AND METHODS

Between 1981 and 1997, 27 patients came to our institution for treatment of injuries sustained in falls from a hunting tree stand. The charts of each case were reviewed retrospectively. Data were collected regarding age, height of fall, type of injury, level of injury, neurologic examination, treatment, and associated injuries. In addition, information was sought on whether alcohol was involved. Spinal fractures were categorized into burst fractures if the anterior and middle columns were involved, compression fractures if the anterior column only was involved, and miscellaneous fractures. The percent of canal compromise was noted on all burst fractures if a computed tomographic (CT) scan or myelogram was done.

RESULTS

In 16 consecutive hunting seasons (1981-1997), 27 patients came to our institution for evaluation and treatment of spinal injuries related to falls from tree stands. There were no fatalities. All the patients were male; the average age was 40.8 years (range, 16 to 75 years). The average height of fall was 19.6 feet (range, 10 to 35 feet). Three patients (11%) had positive blood alcohol levels.

There were 17 (63% of patients) burst fractures, 8 (30%) compression fractures, and 5 (19%) miscellaneous fractures. The miscellaneous category had one coronal sacral body fracture, one bilateral jumped-locked cervical facets, two lamina fractures, and one transverse process fracture (Table). Two of the patients with burst fractures had concomitant compression fractures at another level. One patient had a thoracic burst fracture with lamina fracture of the seventh cervical vertebrae. Three patients (11%) had injury to the cervical spine. Eleven patients (41%) had injury to the thoracic spine. Seventeen patients (63%) had injury to the lumbar spine. One patient (<1%) had injury to the sacrum. There were nine patients (33%) who had injuries involving multiple spinal levels.

The neurologic examination was normal for 15 of the patients. The remaining 12 patients (44%) had a neurologic deficit on initial presentation. No patient had a deterioration of neurologic function because of treatment. One patient with a coronal fracture through the sacrum had sacral root dysfunction on initial presentation that resulted in bladder and erectile dysfunction. However, this completely resolved over a 6-month period. There were six patients who had immediate paraplegia, one patient with immediate quadriplegia, two patients with cauda equina syndrome, one patient with Brown-Sequard's syndrome, and one patient who had a left hemiparesis. This last patient had a cerebrovascular accident at some time after the fall and before presentation to the emergency room. He denied loss of consciousness or head trauma. A CT scan of his head on initial evaluation revealed findings consistent with an acute stroke in the right middle cerebral artery distribution.

Sixteen patients (59%) were treated with some form of simple orthosis only. Eleven of these were treated with thoracolumbosacral orthoses, four were treated with lumbosacral corsets, and one with a cervical collar. Nine patients (33%) required operative treatment. Most often, this involved posterior decompression and fusion. One patient was treated with halo-vest immobilization for lamina fractures of the first and second cervical vertebrae.

TABLE. Summary of Injuries Sustained From Falls Related to Tree Stands

Patient	*Age*	*Height of Fall*	*Type of Injury*	*Level of Injury*	*Canal Compression Fracture*	*Examination*	*Treatment*	*Associated Injuries*
1	24	20 ft	Compression fracture	T4		WNL	TLSO	Yes
2	35	20 ft	Burst fracture	T11, L2	35/15%	WNL	TLSO	
3	20	10 ft	Jumped-locked facets	C6-7		Quadriplegic	Surgery	
4	59	15 ft	Lamina and pedicle fracture	C1,C2		Brown-Sequard's syndrome	Halo	Yes
5	35	Unknown	Burst fracture	L1	50%	Paraplegic	Surgery	
6	29	25 ft	Sacral body fracture	S2-3		Sacral nerve root injury	Observation	Yes
7	16	35 ft	Compression fracture	L2		WNL	TLSO	
8	39	20 ft	Burst fracture	T8	50%	Paraplegic	Surgery	Yes
9	43	10 ft	Burst fracture	L1	>50%	WNL	Surgery	
10	57	15 ft	Burst fracture	T12	60%	Cauda equina syndrome	Surgery	Yes
11	61	12 ft	Burst and/or lamina fracture	T4/C7	NA	Paraplegic	TLSO/Cervical collar	Yes
12	61	20 ft	Burst fracture	T5	100%	Paraplegic	TLSO	Yes
13	16	20 ft	Burst fracture	T4-5-6	20%	Paraplegic	TLSO	Yes
14	43	30 ft	Burst fracture	L1	40%	Cauda equina syndrome	Surgery	
15	33	35 ft	Compression fracture	L1, L2		WNL	Corset	Yes
16	31	20 ft	Compression fracture	T12, L1		WNL	TLSO	
17	52	15 ft	Compression and/or burst fracture	L1, T12	30%	WNL	Corset	Yes
18	42	18 ft	Burst fracture	L1	50%	WNL	Surgery	Yes
19	39	20 ft	Burst fracture	L1	100%	Paraplegic	Surgery	
20	43	15 ft	Compression fracture	T3		WNL	Observation	Yes
21	52	30 ft	Transverse process fracture	L1-4		WNL	Corset	
22	39	16 ft	Compression fracture	L2		WNL	Corset	
23	22	30 ft	Burst fracture	L3	40%	WNL	TLSO	
24	48	10 ft	Burst fracture	L1	50%	WNL	TLSO	Yes
25	54	16 ft	Burst fracture	L2	50%	WNL	Surgery	Yes
26	75	15 ft	Compression and/or burst fracture	T5/T12, L1	0%	Hemiparesis	TLSO	Yes
27	34	18 ft	Burst fracture	L2	30%	WNL	TLSO	Yes

WNL = normal neurologic examination; TLSO = thoracolumbosacral orthosis; NA = not available.

There were sixteen patients (59%) who sustained injuries in addition to their spinal injuries. Ten of these patients had a fracture or dislocation of the appendicular skeleton. There were two radius fractures, one calcaneus fracture, one tibial plateau fracture, one perilunate dislocation of the wrist, one ankle fracture, one subtalar dislocation, one scapula fracture, one pubic ramus fracture, and one clavicle fracture.

DISCUSSION

Several studies have reported on injuries sustained as a result from falls from a height. Ebong[2] reported a series of 60 farmers who had sustained injuries because of falling from trees. This was the most common cause of traumatic paraplegia and quadriplegia, and the risk of any injury increased with age. Barss et al[3] also reported on patients' falls from trees; they found that forearm fractures were the most common injury. A review of 156 spinal injuries by Anderson and Schutt[4] revealed that automobile accidents and falls were the most common causes and severity of the injury increased with age. Lowenstein et al[5] found that 9 out of 12 patients who had fallen between 20 and 100 feet sus-

tained spinal injuries, two of whom became paraplegic.

Ten hunting-related spinal cord injuries were reported by Price and Mallonee[6] for a 6-year period. All the injuries resulted from falls from trees or tree stands. Fifty percent of the injuries resulted in permanent neurologic damage. The average age of the patients was 41 years. The height of the falls was between 15 and 30 feet. They also estimated the incidence rate of injury as less than 1/100,000 licensed hunters.

In 1991, Urquhart et al[7] reported on the types of injuries sustained as a result of falling from tree stands. There were 19 patients with one death in their series. Most patients suffered fractures of the long bones and spine. Thirty-three percent of the patients had permanent paralysis. Of significant note is that 21% of the patients had elevated blood-alcohol levels and a surprisingly high number (83%) of the hunters fell out of self-constructed stands.

A fall from a height can be a significant cause of morbidity and/or mortality. The type and amount of trauma sustained from a fall are influenced by many factors. These factors include the time duration of impact, velocity of impact, landing surface, orientation of body at impact, distribution of force, secondary impacts, and age and physical condition of the patient. Many of these factors are directly affected by the hunting setting. For example, most big game hunting seasons in which tree stands are used are during the colder months of the year. Thus, hunters usually wear bulky clothing. This provides added air resistance, which slows the velocity of the fall and affects the distribution of force by acting as a cushion to soften the impact. The height of the fall directly influences the velocity of impact. Most hunters who use tree stands are 10 to 30 feet above the ground. The maximum impact velocity, or terminal velocity, is limited largely by air resistance and for the human body is approximately 120 miles per hour and requires a height of 480 feet at sea level.[5] There have been many cases of humans surviving falls that resulted in the victim impacting at terminal velocity. The average height of fall in our series was close to 20 feet, which can result in an impact velocity up to 25 miles per hour.[5] Hunters falling from trees can also sustain secondary impacts with tree limbs. These secondary impacts affect the body orientation at final impact, can cause additional injuries, and can also reduce the final impact velocity.

A hunter must either get into or get out of his or her stand under low-light conditions or during total darkness. This can increase the risk for falls and subsequent spinal injury. The cause of the fall could not be defined in most cases. However, some causes included falling asleep, slipping, and faulty construction of the stand. Hunter education should help prevent some falls due to these causes. Information on the types of tree stands used by the patients in this study was not available. Most commercially available tree stands warn hunters of the risk of falls and recommend the use of safety straps while ascending, sitting, and descending from the stand.

Most people would agree that hunting while under the influence of alcohol is not sound judgement. However, 11% of our patients tested positive for alcohol during routine emergency room toxicology screens. No patient was over the North Carolina legal limit for driving. The use of an in-field breathalyzer by wildlife officers during routine hunter spot checks, resulting in severe penalties if positive, might help deter the use of alcohol while hunting. In addition, hunter education focusing on safe climbing techniques, use of safety straps, and abstinence of alcohol while hunting should help to reduce the incidence of falling accidents. Hunters should also be made aware of the potential risk for severe spinal injuries when using a tree stand.

We fully acknowledge the limitations of a retrospective chart review study. However, the nature of the mechanism of injury and individuality of each injury prevents a thorough randomized, prospective analysis. Also, it should be noted that in every case all distances of height of fall are estimations made by the patients. No attempt was made to verify or measure actual heights of the falls.

Falls from tree stands while hunting can result in serious bodily injury, particularly spinal injuries. In this series, 44% of the falls resulted in injuries with neurologic deficit and almost 60% resulted in associated injuries. Paraplegia was the most common neurologic complication. Injury to the lumbar segments of the spinal column was the most common with burst fractures being the most common fracture type. One third of the patients had injury to multiple spinal levels. Aggressive hunter education programs should help reduce the incidence of these potentially serious accidents.

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