

## Original Article

# Traumatic spinal injuries on farms: Patients treated in the national spinal unit of Ireland 2005–2015



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## ABSTRACT

**Introduction:** Farming is a major industry in Ireland, employing 6% of the workforce but accounts for 40% of workplace fatalities (Meredith, 2008).<sup>1</sup> The use of machinery and proximity to large livestock poses significant risk for spinal injuries. This study reviews mechanism of injury, injuries sustained, and the treatment undertaken.

**Results:** Of 31 patients, 26 sustained high-energy injuries with machinery and livestock implicated in the majority of accidents. 77% sustained poly-trauma and 52% had permanent neurological injury.

**Conclusions:** The proximity to heavy machinery and livestock pose significant risk for spinal injuries. This study should encourage increased efforts to improve farm safety.

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## 1. Introduction

The incidence of spinal cord injuries (SCI) has been estimated to be from 15 to 40 cases per million per population worldwide.<sup>2</sup> In the Republic of Ireland this translates to approximately 160 new cases of SCI per year. The National Spinal Cord Injury Database (NSCID) in the US studies the demographics of such injuries and has shown that high-energy impacts, predominantly road traffic accidents (RTA) are responsible for the majority of cases (45.6%), with falls in second place with 19.6% and the remainder made up of sporting injuries, violence and others.

The mean age at the time of spinal cord injury has increased in North America from 28.6 years in the 1970s to 38 years in 2000. The proportion of individuals over the age of 60 has increased and there had been a downward shift in the ratio of men to women who sustain these injuries. Falls in the elderly in industrialised countries is causing an increase in the proportion of elderly patients who present with spinal injuries.

The most common level for these injuries to occur is the cervical region (54.1%), with thoraco-lumbo-sacral regions making up 45.2%. This is most likely due to the significant lever arm about the

cervico-thoracic junction and the reduced stability of the neck when compared to the torso.

With regard to high-energy accidents, farms are common sites for such incidents. A survey in 2006 recorded over 1700 injury-causing accidents occurring on 95,000 farms nationwide, with farming accounting for 40% of all workplace injuries despite only employing 6% of the workforce.<sup>3</sup> Literature from the UK reports that farmyard injuries in young adults and the elderly usually result from machinery-related incidents, while children tend to be injured by livestock and motor vehicle collisions.<sup>4</sup> McNamara et al. found that animal-related incidents accounted for 65% of all farming injuries in Ireland.<sup>3</sup>

Our study will review traumatic spinal injuries in the farming population over a 10-year period. Given the significant morbidity, both physical and psychological, associated with spinal injuries, it is hoped that this study will provide some insight into how these accidents could be prevented in future.<sup>5, 6</sup>

## 2. Methods

This is a retrospective study. 31 patients who suffered traumatic spinal injuries on farms and underwent treatment in the National Spinal Unit between January 2005 and December 2015 were identified using the Hospital In-Patient Enquiry (HIPE) system. Once identified, these patients' files were then reviewed and data collected including age, sex, mechanism of injury, injuries sustained, management, and clinical outcomes.

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**Table 1**  
Patient age distribution.

Age Group (years)	Numbers
<30	2
30–60	16
>60	13

### 3. Results

31 patients were treated for spinal injuries in the National Spinal Unit following farmyard accidents between 2005 and 2015. A table is included in the [Appendix A](#) detailing the information gathered during this study including demographics, mechanism of injury, injury sustained, treatment, and complications.

The majority of patients were male (87%) and the average age of those injured was 57 years old (range 17–87 years old). [Table 1](#) demonstrates the age distribution for those injured. As expected, many are within the typical working age range (30–60 years old), however it is concerning that 13 (41%) of those injured were in the older age group.

Of the 31 patients, only one was a direct admission with the majority being transferred from other hospitals for management of their spinal injuries. This is understandable as the National Unit is based in a hospital located in a city-centre and patients were initially assessed and managed in their regional centre prior to transfer.

[Table 2](#) outlines the mechanism of injury for this group. Machinery (29%) and livestock (32%) were implicated in the majority of injuries sustained. Falls (16%) and weights falling from above (22%) make up the remainder. Tractors were the cause of all machinery-associated injuries except in one case where a patient was thrown from a quad bike.

With regard to animal-related injuries, the majority involved the farm worker being injured by a cow or bull, however in three cases the injury was caused by a horse. In two cases the patient was thrown by their horse, while the third sustained a kick to their back while grooming the horse. Excluding horses, in this analysis cows<sup>4</sup> were the cause of a greater number of injuries than bulls<sup>3</sup>.

Bales of hay were the cause of the injuries in 16% patients. Mostly these are large round bales which would average about 500KG weight. Interestingly, we did not have any injuries in this

**Table 2**  
Mechanism of injury.

Mechanism of injury	
Fall	5 (16%)
Machinery	9 (29%)
Livestock	10 (32%)
Weight from above	7 (23%)

**Table 3**  
Number of spinal levels affected by trauma.

Levels of Spinal Injury	
1 level	25 (81%)
2 levels	5 (16%)
3 levels	1 (3%)

**Table 4**  
Level at which injury occurred.

Spinal Level	
C0-2	8
C3-7	14
T1-12	8
L1-5	7

cohort due to the handling of large round silage bales and some of these can weigh up to 1000KG

The high-energy of these incidents can be appreciated with 24 (77%) of the 31 patients sustaining poly-trauma with multiple injuries to various body regions. Compound limb fractures, degloving injuries, crushing chest injuries, intra-cranial haemorrhages, and abdominal viscera injuries were all recorded in this patient cohort.

Concerning spinal injuries alone, 81% suffered fractures at a single level and 6 patients (19%) had non-contiguous spinal injuries including one patient with injuries at 3 sites in the spine ([Table 3](#)). The average age of this group with non-contiguous injuries was 60 years.

In total, there were 37 separate spinal column injuries in this group. The cervical spine region accounts for the majority of these fractures (56%) with the thoraco-lumbar regions making up 44% of fractures sustained ([Table 4](#)). This finding is in keeping with the data from the NSCID study where they found that the more mobile and less supported cervical spine is at increased risk of injury in trauma in comparison to the more stable thoracic and lumbar regions<sup>2</sup>.

With regard to neurological spinal injury, almost half of all patients were fortunate to have sustained significant spinal trauma with no neurological sequelae (48%). As [Table 5](#) outlines, the remainder suffered spinal cord injuries of varying severity with seven patients (23%) having ASIA A complete neurology below the level of the spinal injury. The average age of the group with complete neurology was 45 years.

With regard to patient management, 20 patients (65%) underwent surgical procedures to stabilise their spinal fractures with decompression of the spinal canal if indicated. The remaining 11 patients (35%) were conservatively managed with HALO frames, Minerva brace, Miami J collars, or thoraco-lumbar support brace as indicated.

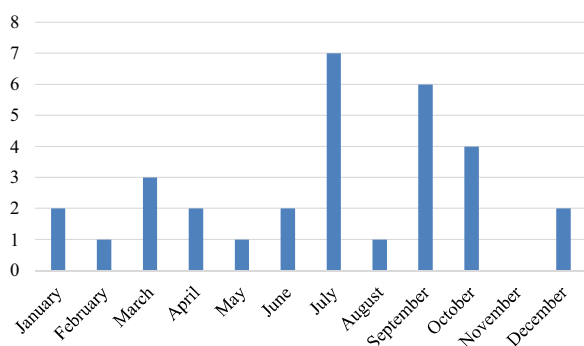
Complication rates following treatment are outlined in [Table 6](#). Spinal injury patients are at significant risk for complications due to reduced mobility. Urinary tract infections and pressure sores are common complications in this population with spasticity and psychiatric issues also frequently seen.<sup>6,7</sup> In this study, pneumonia and pressure sores were common and led to prolonged length of stay for these patients. Considering the environment in which the injury occurred there were no deep wound infections of the spine. There were three tibial fractures, one of which was compound, treated surgically. There was a superficial wound infection in the compound tibial fracture which responded to antibiotics and all three tibial fractures healed.

**Table 5**  
Neurological injury sustained.

Neurology	
Nil	15 (48%)
ASIA D	2 (6%)
ASIA C	4 (13%)
ASIA B	3 (10%)
ASIA A	7 (23%)

**Table 6**  
Complications following treatment.

Complications	
LRTI	10 (33%)
AKI	1 (3%)
UTI	2 (6%)
PE	2 (6%)
Decubitus Sore	4 (13%)
Mortality	1 (3%)



**Chart 1.** Seasonal Trend in Patient Admissions.

There was one mortality recorded. This patient sustained a C5/ C6 fracture subluxation with complete neurological injury at C6 level. He underwent an anterior cervical decompression and fusion at this level but developed a number of complications in the post-operative period, including respiratory failure requiring tracheostomy and ICU admission. While in ICU, the patient had a cardiac arrest and passed away.

As would be expected the highest number of injuries occurs when farms are at their busiest with the highest number of injuries in July, September and October (Chart 1).

The number of farm related spinal injuries admitted to the National Spinal Injuries Unit for treatment has shown a trend towards a gradual increase over the time period of the study (Chart 2).

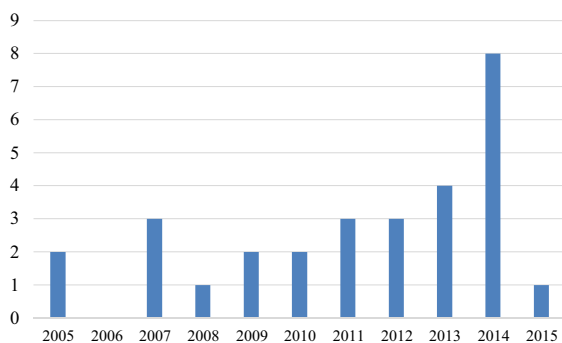
3 (13%) of the patients were female aged from 17 years to 67 years. One was kicked by a cow, one was hit by a tractor and one was injured by a bale of hay.

#### 4. Discussion

This study demonstrates 4 significant risk factors on Irish farms that may result in spinal fracture with or without spinal cord injury. These are 1. handling livestock, and we have seen more injuries from cows than bulls, 2. the use of heavy farm machinery, 3. movement/transportation of large hay bales and 4. falls from heights.

The demographics of those injured is typical of farming injuries, with older males representing the majority (87% male, average age 57 years). This is similar to what was seen in previous studies of farming injuries carried out in Ireland (73% male) and the US (82% male).<sup>8,9</sup>

Many farm workers suffered multiple injuries and even injuries to more than one level of the spinal column (19%). Non-contiguous



**Chart 2.** Patient admissions per year.

spinal fractures were reported in 9.7% of trauma cases reviewed by Gupta in 1989 and 15.2% of cases by Henderson in 1991.<sup>10,11</sup> This study follows a similar pattern with multi-level injuries associated with high-energy trauma as seen in those studies.

In comparison to the average age of all patients admitted with spinal injuries, the mean age of this cohort of patients with spinal injuries, at 57 years is much higher. Only 2 patients were under the age of 30 years and this probably at least partially reflects the paucity of young farmers.

The average age of farmers in Ireland as in the rest of Europe, has been rising significantly according to CSO figures. In 2000 the average age was 51 years, in 2010 it was 55 years and most recently the figure is 57 years. This is similar to the average age of our study group. With increasing age alone becoming a more significant risk factor in spinal injuries, and the average age of farmers (whose workplace is considered to be one of the most dangerous work environments) continuing to rise the importance of making farmers aware of the increasing risks of serious accidents as they age and continue to work cannot be overemphasised.<sup>12</sup> Our data would suggest that there is a trend towards an increasing number of farm related spinal injuries presenting to our unit for treatment.

Most injuries occur in the summer months as expected, when farms are at their busiest.

Many farm workers suffered multiple injuries and 19% had non-contiguous spinal column injuries. More than half of the patients had long-term neurological injury, with 7 of 31 sustaining complete loss of function below the level of injury. The majority of patients also required surgical intervention with the concomitant associated risks. Despite the environment in which the injuries occurred there were no deep wound infections of the spine recorded.

In conclusion, it would unfortunately seem that the incidence of farm related spinal injuries is increasing. This can be in part attributed to the aging profile of farmers combined with the fact that increased longevity is an independent risk factor in spinal trauma. Prevention strategies have been shown to have had a significant impact on the incidence of spinal injury in rugby and diving. Car safety has been improved with seat belt use and many other technologies. There is a need to educate the farming population of where the main risks of significant injury lie and to advise on strategies to try and minimise the risk of sustaining these potentially catastrophic injuries.

#### Conflict of interest

The authors declare that they have no conflict of interest.

#### Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of retrospective study formal consent is not required. This article does not contain any studies with animals performed by any of the authors.

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None.

## Appendix A.

See Table A1.

Table A1

Collected study data.

Patient	Date of Admission	Sex	Age at injury	Mechanism of Injury	Fracture level (C0-2, C3-C7, T1-12, L1-5)	Poly-trauma	Associated Injuries	Treatment Strategy	Neurologic Status on Admission	Complications
1	11/06/2005	Male	48	Attack by bull	C3-7	Yes	Facial and chest injuries	Surgical Intervention	C6 – ASIA A	Respiratory sepsis causing asystolic arrest, decubitus sore
2	25/09/2005	Male	60	Fall from 7 ft wall	NA	No	N/A	Conservative – MIAMI J Brace	C5 – ASIA C	Nil
3	09/02/2007	Male	63	Fall from horse	C0-2, C3-7	No	N/A	Surgical Intervention	Nil	Pneumonia, Right-sided hemothorax
4	27/07/2007	Male	17	Heavy piece of machinery fell on him	T1-12	Yes	Large laceration to left thigh, comminuted fracture left tibia and fibula, bilateral hemothorax	Surgical Intervention	T6 – ASIA A	Nil
5	28/09/2007	Male	50	Hit by 500 kg bale from height	C0-2, C3-7, L1-5	No	N/A	C spine: Conservative (MIAMIJ), L Spine (Surgical Intervention)	L1 – ASIA A	Nil
6	13/12/2007	Male	58	Kicked by bull	C0-2, C3-7	Yes	Rib fractures, comminuted fracture – Right tibia	Conservative – Minerva, then Miami J Collar	Nil	Nil
7	24/06/2008	Male	75	Hit by bucket of heavy machinery	C3-7	Yes	Facial injuries	Conservative – MIAMI J Brace	Nil	Nil
8	10/03/2009	Male	44	Hit by 200 kg bale from back of trailer	L1-5	No	N/A	Surgical Intervention	nil	Pneumonia
9	31/10/2009	Male	58	Steel door fell on patient	C3-7	Yes	Scalp lacerations	Surgical Intervention	C6 – ASIA B	Recurrent UTIs
10	08/07/2010	Male	41	Knocked over by cow	L1-5	No	N/A	Surgical Intervention	Nil	Nil
11	22/10/2010	Male	43	Kicked by bull	T1-12	Yes	Rib fractures	Surgical Intervention	Nil	Nil
12	22/04/2011	Male	64	Fell from tractor & drove over him	C3-7, T1-12	Yes	Rib fractures, pleural effusion	Surgical Intervention	C6 – ASIA A	Pneumonia, pleural effusions, decubitus sore
13	03/07/2011	Male	51	Crushed by Tractor	L1-5	Yes	Small bowel perforation	Surgical Intervention	L2 – ASIA A	Pneumonia
14	30/07/2011	Female	48	Kicked by cow	L1-5	Yes	Fractured ribs, intra-cranial haemorrhage	Conservative – Hyperextension Brace	Nil	Nil
15	10/09/2011	Male	49	Fall climbing over gate	c3-7	No	N/A	Surgical Intervention	C6 – Asia D	Nil
16	20/09/2012	Female	57	Kicked from behind by horse	c3-7	No	N/A	Surgical Intervention	C6 – Asia B	Pneumonia, pulmonary oedema and bilateral pleural effusions
17	30/09/2012	Male	68	Ran over by quad bike	C3-7, T1-12	Yes	Rib fractures	Surgical Intervention	C4 – ASIA A	Decubitus sore, Asystolic cardiac arrest (RIP)
18	11/12/2012	Male	58	Fall from 8 ft hay stack	C0-2, C3-7	No	N/A	Conservative – Miami J Brace	C5 – ASIA C	Pneumonia
19	26/01/2013	Male	69	Hit by cow	C0-2	No	N/A	Conservative – Halo Brace	Nil	UTI
20	27/07/2013	Male	55	Mechanical fall	C3-7	No	N/A	Surgical Intervention	C7 – ASIA D	Nil
21	15/08/2013	Male	63	Bale of hay fell from above onto patient	c3-7	No	N/A	Surgical Intervention	Nil	Nil
22	04/10/2013	Female	67	Hit by tractor	C0-2	Yes	N/A	Conservative – Halo Brace	Nil	AKI
23	11/01/2014	Male	42	Gate fell on him from above	L1-5	No	N/A	Surgical Intervention	L3 – ASIA B	Nil

Table A1 (Continued)

Patient	Date of Admission	Sex	Age at injury	Mechanism of Injury	Fracture level (C0-2, C3-C7, T1-12, L1-5)	Poly-trauma	Associated Injuries	Treatment Strategy	Neurologic Status on Admission	Complications
24	09/03/2014	Female	17	Bale of hay rolled over her	L1-5	Yes	Comminuted open fracture – Right tibia	Surgical Intervention	L1 – ASIA A	Tibia wound infection
25	25/03/2014	Male	54	Fall from horse, horse stepped on patient	T1-12	Yes	Pelvic fracture	Surgical Intervention	Nil	Pneumonia and pleural effusion
26	05/04/2014	Male	64	Fell getting out of tractor	C0-2	No	N/A	Conservative – Halo Brace	Nil	Pneumonia
27	22/07/2014	Male	80	Fall from tractor cab	C0-2	Yes	Degloving injury to scalp	Conservative – Halo Brace	Nil	Nil
28	30/07/2014	Male	75	Bale of hay fell on him	T1-12	No	N/A	Surgical Intervention	T11 – ASIA C	Pneumonia, small PE
29	04/09/2014	Male	75	Hit by tractor wheel	T1-12	Yes	Fractured ribs	Conservative: –TLSO Brace	Nil	Nil
30	20/10/2014	Male	87	Rolled over by tractor	T1-12	Yes	Rib fractures, Medial meniscus tear – Right knee	Surgical Intervention	Nil	bilateral PEs, decubitus sore, wound sepsis
31	02/05/2015	Male	76	Attack by cow	C3-7	Yes	Scalp lacerations	Conservative – MIAMI J Brace	C5 – ASIA C	Nil

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