ANZ J. Surg. 2003; **73**: 331–334

ORIGINAL ARTICLE

SPINAL AND SPINAL CORD INJURIES IN HORSE RIDING: THE NEW SOUTH WALES EXPERIENCE 1976–1996

JUSTIN P. ROE,* THOMAS K. F. TAYLOR,*† IAN A. EDMUNDS,* ROBERT G. CUMMING,‡ STEPHEN J. RUFF,* MEG D. PLUNKETT-COLE,* MARJE MIKK§ AND RICHARD F. JONES§

**Department of Orthopaedics and Traumatic Surgery, the Royal North Shore Hospital, †Departments of Surgery and ‡Public Health and Community Medicine, the University of Sydney and §The Department of Rehabilitation Medicine, Prince Henry/Prince of Wales Hospital, Little Bay, New South Wales, Australia*

Objectives: The objective of the present study was to determine the incidence of acute spinal cord injuries (ASCI) in all forms of horse riding in New South Wales (NSW) for the period 1976–1996. Other aims of the present study were to compare and contrast ASCI with vertebral column injuries (VCI) without neurological damage and to define appropriate safety measures in relation to spinal injury in horse-riding.

Design: A retrospective review was done of all ASCI cases (n = 32) admitted to the two acute spinal cord injury units in NSW for the cited period. A comparable review of VCI cases (n = 30) admitted to these centres for the period 1987–1995 was also undertaken.

Results: A fall in flight was the commonest mode of injury in both groups. Occupational and leisure riding accounted for 88% of ASCI and VCI. The incidence of ASCI is very low in those riding under the aegis of the Equestrian Federation of Australia – two cases in 21 years; and there were no cases in the Pony Club Riders or in Riding for the Disabled. The difference in the spinal damage caused by ASCI and VCI is in degree rather than kind. Associated appendicular/visceral injuries were common.

Conclusions: No measures were defined to improve spinal safety in any form of horse riding. The possible role of body protectors warrants formal evaluation. Continued safety education for all horse riders is strongly recommended.

Key words: horse riding, spinal cord injury.

Abbreviations: ASCI, acute spinal cord injury; BETA, British Equestrian Trade Association; NSW, New South Wales; VCI, vertebral column injuries.

INTRODUCTION

Horse riding is an extremely popular, well-organized sport in Australia as is simple leisure riding at all ages. Furthermore, the horse is still widely used in rural and associated industries, though this has decreased in recent times. In New South Wales (NSW) in 1996, 43 000 persons in the age range 15–55 years took part in organized riding (excluding leisure riding); 63% of the participants were women.[1]

Injury is not an unexpected risk in horse riding as it involves two creatures of dynamically different species. Bixby-Hammett and Brooks have pointedly commented that 'no horse is a safe horse, some are safer than others, but the horse is a potentially lethal animal'.[2] A horse and rider together comprise an asymmetric couple and the former can act both unpredictably and independently of the latter. A fall from a horse travelling at high speed (up to 65 kph) where the rider's head is up to four metres from the ground has the potential for catastrophic injury on impact.[3] This may be compounded if the horse, which may weigh up to 500 kg, falls on the rider.

J. P. Roe FRACS; **T. K. F. Taylor** FRACS, DPhil (Oxon); **I. A. Edmunds** FRACS; **R. G. Cumming** MB PhD; **S. J. Ruff** FRACS; **M. D. Plunkett-Cole** RN; **M. Mikk** MB BS; **R. F. Jones** FRACP, FACRM.

Correspondence: Emeritus Professor T. K. F. Taylor, Department of Orthopaedics and Traumatic Surgery, The Royal North Shore Hospital, St Leonards, New South Wales 2065, Australia.
Email: tktaylor@med.usyd.edu.au

Accepted for publication 13 January 2003.

Buckley *et al.* reported that the rate of hospitalization resulting from falls while horse riding in New Zealand is comparable to the rate from rugby injuries.[4] These data represent a horse-riding population comparable to that in Australia. They submitted that injuries caused by falls from horses deserve the attention of both New Zealand and Australian public health authorities and all other organizations and persons in a position to promote safety in horse riding.

There are no data on the incidence in Australia of acute spinal cord injury (ASCI), one of the most catastrophic of injuries in horse riding. This study was undertaken to correct this deficiency and to identify possible causal factors and preventative measures.

CLINICAL MATERIAL AND METHODS

The management of ASCI in Australia has been on a supra-regional basis since the early 1970s. There are two spinal cord injury units in NSW – one at the Royal North Shore Hospital and the other at the Prince of Wales Hospital. This retrospective study covers all 32 patients admitted to the two units in the period 1976–1996; there were also two patients with significant nerve root deficits associated with cervical spine injuries.

It was considered purposeful to compare and contrast data related to ASCI with that from a comparable series of vertebral column injuries (VCI) sustained in horse-riding without neurological damage. To this end a similar review was undertaken of 30 patients with VCI who were admitted to the two parent institutions in the 9-year period 1987–1995. The latter group is not representative of the frequency of such injuries as many patients with simple vertebral fractures and dislocations are managed at

other teaching, district and base hospitals. Accident details were confirmed by interview in 53 out of the 64 subjects. It is well established that medical record descriptions and surrogate reports of accident details may be inaccurate.[5]

While this is primarily a descriptive study, we have chosen to conduct statistical tests for findings that appeared to differ between groups or over time. We used Fisher's exact method to do χ^2 tests for comparing proportions; two sample *t*-tests for comparing means; and Poisson methods for investigating variation in incidence rates over time.

RESULTS

Age and sex distribution

There were 21 men (age range 22–80 years) and 13 women (age range 14–61 years) in the ASCI group (Table 1). Only one of those under 25 years of age was a man and the sex difference was statistically significant ($P < 0.01$). At the other end of the age scale only one of the 11 patients over the age of 35 years with an ASCI was a woman. Similarly, there were no women in the VCI group past the same age point.

Year of injury

There were 10 ASCI in the period 1976–1985 and 24 between 1986 and 1996. The highest number of cases was in 1989 ($n = 6$), a peak much higher than expected by chance fluctuation (*P*, Poisson method: 0006).

Annual incidence rate

There was an average of 1.6 cases per year during the 21-year study period. Using the total NSW population at the midpoint of the study (1986) as the denominator produced an incidence rate of 0.3 per million per year. The annual incidence rate in men was twice as high as in women.

Type of riding

Occupational and leisure riding were the most frequent accident settings. The former was more common in men and the latter in women (*P*, χ^2: 0.02). There were two ASCI in competitive equestrian riders and one of these occurred at practice (Table 2).

Table 1. Age and sex distribution of 64 injured riders

Age range (years)	ASCI†		VCI††	
	Male‡	Female§	Male††	Female§§
0–15	–	1	–	1
16–25	1	7	4	6
26–35	4	3	4	9
36–45	6	1	3	–
46–55	4	–	3	–
56–65	3	1	–	–
66+	3	–	–	–
Total	21	13	14	16

†Combined mean age (male and female): 39.3 ± 18.4; ‡mean age: 46.7 ± 17.6; §mean age: 27.5 ± 12.9; ††Combined mean age (male and female): 28.1 ± 10.4; ††mean age: 32.2 ± 12.00; §§mean age: 24.5 ± 7.4. ASCI, acute spinal cord injury; VCI, vertebral column injuries.

Riding experience

The injuries were sustained by riders who had considerable experience (Table 3). The difference in the riding experience of the two groups is statistically significant when men and women were considered together.

Protective equipment

A protective helmet was worn by 47% of the VCI riders compared to 27% of those who sustained an ASCI. Data were not available for 22 riders. However, there was no statistically significant difference in helmet wearing across the injury settings for both ASCI and VCI.

There was no significant difference in helmet wearing between men and women who sustained an ASCI. However, among those who sustained a VCI, women were more likely to be wearing a helmet (10 of 10 women for whom helmet data were available) than men (four of 10 men; *P*, χ^2: 0.0005). A body protector was not worn by any of the injured riders.

Mode of injury

This was established for 59 injured riders (Table 4). A fall in flight, defined as a fall from a horse in motion, was by far the most common mode of injury in ASCI and VCI, 45 and 65%, respectively. Lack of attention to equipment and falls from stationary animals accounted for 10% of injuries collectively.

Type of spinal injury

These are given in Table 5. Burst fractures result from axial loading. A wedge fracture requires an additional flexion vector. Fracture dislocations/subluxations at all spinal levels occur when there is an added rotatory component in the injury mechanism.

Table 2. The sex incidence and accident setting for ASCI and VCI

Setting	ASCI		VCI	
	Male	Female	Male	Female
Occupational	13	3	5	–
Leisure	6	9	7	9
Competitive	1	1	1	4
Unknown	1	–	1	3
Total	21	13	14	16

ASCI, acute spinal cord injury; VCI, vertebral column injuries.

Table 3. Mean years of riding experience

	ASCI	VCI
Males	33.4 (SD: 21.9)	14.4 (SD: 14.4)
Females	14.6 (SD: 17.0)	8.3 (SD: 7.3)
Males and females	25.7 (SD: 21.8)	11.2 (SD: 11.4)
Males compared with females (*P*)	0.02	0.27
All ASCI compared with all VCI (*P*)	0.01	

ASCI, acute spinal cord injury; VCI, vertebral column injuries.

Spinal cord injury

Spinal cord injuries occurred in the three spinal regions – cervical, thoracic and lumbosacral; the two patients with profound nerve root deficits had cervical injuries. Complete transection syndromes (quadriplegia and paraplegia) occurred in 13 patients (41%) and most often in the thoracic spine (61%) (Table 6).

Associated injuries

Concomitant visceral and appendicular skeletal injuries occurred in 40% of ASCI patients with most having multiple injuries and in 17% of the VCI group.

One rider with ASCI had a fractured skull without neurological damage; three others in this group had a closed head injury compared with five in the VCI group. Two of these four riders wore helmets at the time of their accidents.

One patient with an ASCI died 10 days post-injury from cardiorespiratory complications.

Previous riding injuries

Five patients in the ASCI group had had a previous minor injury in riding. One of them, a 40-year-old male occupational rider, had sustained an uncomplicated fracture of L3.

Table 4. Mode of injury in 59 injured riders

Mode	ASCI	VCI
Fall in flight	15	17
Horse and rider fall	5	1
Hit stationary object	4	4
Fall from stationary object	2	–
Fall from gig	1	–
Jumping	3	3
Equipment failure	3	1

ASCI, acute spinal cord injury; VCI, vertebral column injuries.

Table 5. Classification of spinal injuries

Injury type	ASCI	VCI
Fracture with dislocation/subluxation	12	9
Burst fracture	11	7
Wedge fracture	3	6
Others (e.g. odonitoid fracture)	5	8
Unknown	1	–

ASCI, acute spinal cord injury; VCI, vertebral column injuries.

Table 6. The spinal distribution of vertebral trauma and neurological deficit in 64 injured riders

Spinal region	VCI	ASCI	Complete	Incomplete
Cervical	11	13†	4	9
Thoracic	9	8	7	1
Lumbo-sacral	11	11	2	9
Total	30	32	13	19

†Two other riders with cervical injuries had profound root defects. ASCI, acute spinal cord injury; VCI, vertebral column injuries.

DISCUSSION

The demographic characteristics of the injured riders as documented reflects a heterogenous group as might be expected in view of the different types of riding undertaken. Hence collective, raw data are somewhat misleading. There are some imponderables such as the actual extent of leisure riding, let alone the true extent of rural occupational riding. These two categories accounted for 88% of the injuries (ASCI and VCI) where the type of riding was clearly determined (Table 2). Overall there were more men than women in both groups combined which is in contrast to previous reviews of this form of trauma.[2,4,6–9] Occupational riding accounted for 10 ASCI in men aged 35 years or more.

There was a significant increase in the numbers of ASCI in the second half of the study period; occupational injuries increased three-fold. There is no clear explanation for this change.

Comparison of the vertebral column damaged in the ASCI and VCI riders indicates that the mechanisms of injury in the two groups differed in degree rather than actual kind (Tables 5 and 6). Given the way in which the riders were injured it is not surprising that the thoracic spine was so frequently involved. Neither is it surprising that 40% of the injured riders in the ASCI group had concomitant visceral/musculoskeletal injury. The high incidence (87.5%) of complete cord transection in the thoracic cord injuries is an expected finding. Because of the relative narrowness of the thoracic spinal canal, incomplete cord lesions here are quite rare, irrespective of the cause of the trauma.

One of the purposes of the present study was to identify possible preventative measures. Safety in horse riding is a major issue for those involved in this activity, be it sporting or otherwise. The total number of persons involved with horses cannot be defined precisely but the number suffering severe, long-term effects from riding accidents is highlighted in this report from two spinal cord injury units in NSW. Part of the horse-riding community is self-regulated, involving the hobby-rider or the land-owner, with horses as part of their self-interest or livelihood, while other parts are well established with efficient, well-structured organizations to manage their affairs within the formal equestrian world. These organizations actively promote safety and our data show that participation under their aegis carries a very low risk of ASCI, especially in younger equestrians. In 1996, the Pony Club Association (PCA) had 22 000 members in NSW and no ASCI occurred in these young riders. At the same time the Equestrian Federation of Australia had some 3000 registered members in NSW; one rider was injured while competing in an event and another registered member had an accident at practice (Table 2). In the study period there were no ASCI in those who took part in Riding for the Disabled.

We are unable to offer any specific suggestions on the prevention of severe injuries apart from being a member of a registered body which supervises and offers safety guidelines. As reported by Brooks and Bixby-Hammett[10] and Watt and Finch,[11] the efficacy of body protectors in reducing injuries to the trunk and thoracolumbar spine is not yet proven. There are no hard data in the literature to support the wearing of commercially available body protectors. D'Abreu commented on the reduction of spinal injuries in professional jockeys in the UK (from 27 in 1967–1968 to eight in 1973–1974[12]) but since then no figures have been produced to support the wearing of body protectors in race riding made mandatory under the British Jockey Club rules, the British Horse Society horse trials, the Pony Club cross-country riding and Riding Club cross-country riding. The revised British Eques-

trian Trade Association (BETA) Standard of April 1996 states, '[s]pinal protection is not provided by body protectors'.[13] This is a performance standard for protective clothing from the basic health and safety requirements of the European Personal Protective Equipment Directive as of July 1995.

While this paper focuses upon spinal and spinal cord injuries, it is to be acknowledged that they are but one small part of the considerable trauma spectrum which results from horse-riding. For example, the recent review of 232 children admitted to two children's hospitals in NSW[14] serves well to emphasize the frequency and severity of the injuries that occur. In this series, five of the six children with severe head injuries died and none of them was wearing a protective helmet at impact.

This study has clearly shown that riding experience does not protect the individual from injury to the vertebral column (Table 3). Two ASCI and two VCI occurred in riders who could reasonably be classified as novices in this activity. One can conclude that in all forms of horse riding, as in so many health-related matters, safety education is the single, purposeful avenue to pursue. Moreover, education needs to be regularly updated and reinforced. Accidents will always happen and they do not make appointments. There is admirable wisdom in the universal motto of the boy scouts.

ACKNOWLEDGEMENTS

The authors express their gratitude to the injured riders and their families for their participation in this study. Thanks are also due to Mrs J. Mitchell for her assistance with manuscript preparation. The study was supported by SpineCare Foundation, a charity registered in NSW (CFN10864).

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