

# Hand injuries in farmers: A 10-year review

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A retrospective review of hand injuries in farmers was carried out in the Regina Health District. One hundred twelve injuries requiring hospitalization were recorded over 10 years. Injuries presented throughout the year, with a peak in August that was associated with the harvest. An increased rate of injury was also associated with age. Entanglement in machinery comprised 84% of injuries, of which swathers, power take-offs, combines and augers made up the majority of causes. Eighty-one per cent of injuries were open, with injury to the index, long and ring fingers being most common. The overall amputation rate was 30%. Patterns of injury relating to each machine were collected, and from these results a classification system is proposed.

**Key Words:** *Farming; Hand injury*

## **Blessures aux mains en milieu agricole : étude rétrospective sur dix ans**

**RÉSUMÉ :** Une étude rétrospective sur les blessures aux mains en milieu agricole a été menée dans le district de santé de Regina. Cent douze (112) blessures ayant nécessité une hospitalisation ont été relevées sur une période de dix ans. Les blessures sont survenues tout au long de l'année, mais surtout en août au moment des récoltes. L'âge a aussi été associé à un taux élevé de blessures. L'entraînement par un mécanisme de machinerie (faucheuse-andaineuse, prise de force, moissonneuse-batteuse, vis sans fin) a été à l'origine de 84 % des blessures. Dans 81 % des cas, il y a eu blessure ouverte aux doigts; l'index, le majeur et l'annulaire ont été les plus touchés. Le taux global d'amputation a été de 30 %. Nous avons recueilli des données sur les types de blessures associés aux différentes machines et nous proposons, à partir des résultats obtenus, un système de classification.

Farming is a hazardous occupation. The fatality rate for farmers is 2.5 times higher than the mean for all other industries in Canada (1,2). Upper extremity injuries are the most common nonfatal injuries in farmers (2). Hand surgeons who deal with these injuries note patterns in their presentation and scope of injury.

Regina is the tertiary referral centre for southeastern Saskatchewan. It services most of rural Saskatchewan and sees many primary and tertiary problems. It is hypothesized that a retrospective review of hand injuries in farmers would reveal patterns in time, scope and mechanism of injury.

## **MATERIALS AND METHODS**

A retrospective chart review from 1989 to 1999 was carried out at the Regina General Hospital and the Pasqua Hospital.

*International Classification of Diseases*, 9th revision (ICD-9) codes E849.1 and E919.0 relating to injury on the farm were used to pull the records. Charts were then manually sorted relating to upper extremity injury. Only hospitalized patients were included.

Data retrieved from the charts were name, age, sex, date of injury, place of injury, body part injured, structures injured, mechanism of injury, associated injuries and treatment.

## **RESULTS**

Referrals were from southeastern Saskatchewan (Figure 1). One hundred twelve injuries were noted in the 111 patients. There was one fatality (Table 1). One hundred two patients were men with a mean age of 44 years (range two to 74 years) (Table 1). August was the most common month for injury

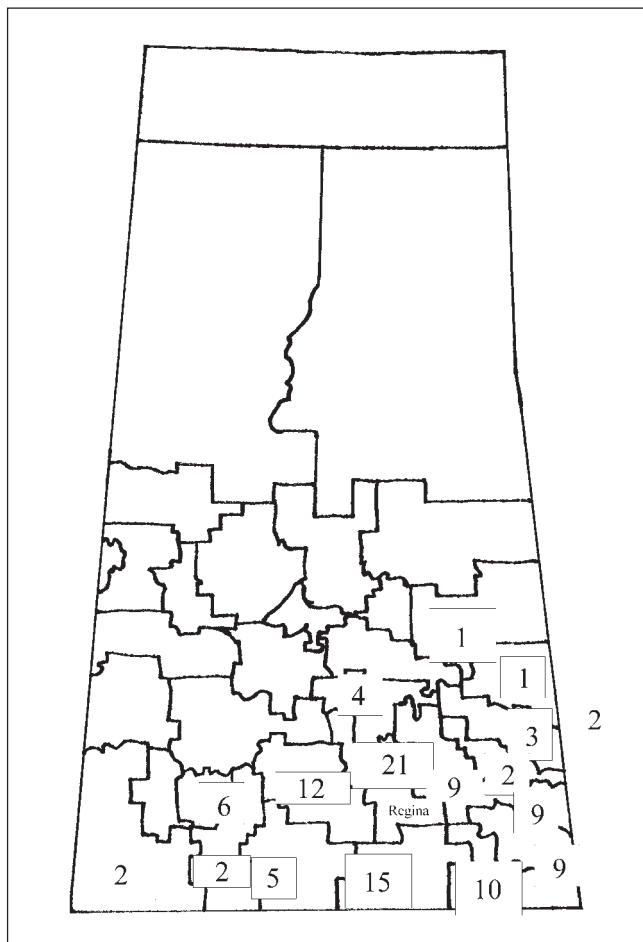


Figure 1) Referral by Health Districts

(Table 2). The body part injured was classified by the digits, metacarpal, carpus and forearm. The index, long and ring fingers were the most commonly injured (Table 3).

Ninety-four of 112 injuries involved entanglement in machinery (Table 4). Fifty-five of 94 injuries involved four machines: swather (eight of 55), power take-off (PTO) (12 of 55), combine (15 of 55) and auger (20 of 55) (Table 5). Ninety-one injuries were associated with open wounds (Tables 6,7). Eighty-seven injuries were associated with a bony injury (Table 7). Thirty-three amputations were performed (Table 8). Eight upper extremity injuries were associated with other injuries, four of which were related to PTO injuries (Tables 9,10).

Twenty replantations/revascularizations were performed, five of which failed (Table 11). Three free flaps, six pedicle flaps, three local flaps and 11 skin grafts were performed (Table 11).

#### Machine-related injuries

Swather injuries occurred in July, August and September (Table 2). The index finger (five of eight) was the most common digit injured (Table 3); the flexor tendon (six of 32) and skin (eight of 32) were the most commonly injured structures (Table 7). One swather injury required amputation (Table 8).

PTO injuries were more common in the colder months, with the thumb (seven of 20) being the most common digit injured (Tables 2,3). Ten of 12 PTO injuries were avulsion injuries (Table 6). Approximately half of the injuries spared the tendons (Table 7). The number of amputations equalled those injuries repaired and reconstructed (Table 8).

October was the most common month for combine injuries, with ulnar-sided digits most commonly being injured (Tables 2,3). Twenty-four of 30 injuries were laceration or crush types (Table 6). Skin, extensor tendon and bone were the most common (35 of 56) structures injured (Table 7). Four combine injuries required amputation (Table 8).

Auger injuries peaked in September but occurred throughout the year (Table 2). Thirty-two of 45 injuries included the index, long and ring fingers (Table 3). Laceration, crush and avulsion were all involved in injuring all components of the hand (Tables 6,7). Eight auger injuries required amputation (Table 8).

#### DISCUSSION

The referral area for the Regina Health District is south-eastern Saskatchewan, which represents roughly half (77,086 of 154,059) of the resident farm population (2).

Farming is a male-dominated occupation, with most injuries related to machine entanglement. The number of injuries per age group revealed an increasing rate with age (Figure 2). This is certainly the clinical impression. Reasons for this may include the use of outdated equipment by older farmers, and the loss of reflexes and judgement with increasing age.

Harvest is the most common farming season for injury. However, PTO injuries are more common in the colder months. This is likely related to two factors: more loose clothing is worn, which increases the risk of becoming entangled in the spinning shaft, and the oil surrounding the drive shaft is more viscous, so when the operator disengages the power to the drive shaft, it continues to spin with more torque than in warmer seasons. Farmers may be able to stop a spinning, disengaged PTO in the summer by grabbing it with their hand, but this same manoeuvre in the winter can produce a serious injury.

Eighty-four per cent (94 of 112) of injuries were the result of entanglement in machinery. Ninety-two per cent (103 of 112) of injuries had some component of crush or avulsion. Eighty-four per cent (98 of 112) were open injuries. The overall amputation rate was 30%. There was a 25% (five of 20) failure rate for replantations/revascularizations. This indicates a high severity of injury coupled with limited treatment options. It is a clinical impression that farmers often want to undergo the procedure that gets them back in the field the soonest, which often means amputation.

Swather injuries were usually related to changing sharp, serrated blades. This often resulted in a laceration of the flexor tendon of the index finger.

Thirty-three per cent (four of 12) of PTO injuries were associated with other injuries. The one fatality was in this group. If a farmer's coat is caught in the shaft, then thoracic and head injuries can occur. PTOs are sold with protective

**TABLE 1**  
**Data for patients referred to Regina Health District for farm-related injuries**

Patient	Age (years)	Sex	Date (day/month/year)	Town	Cause of injury
1	55	M	08/10/1994	Indian Head	V pulley combine
2	61	M	15/06/1991	Creelman	Auger
3	33	M	28/08/1998	Wynard	Grinder
4	61	M	12/10/1996	Broadview	Combine fan
5	46	M	11/11/1992	Oxbow	Bull crush injury DRUJ dislocation
6	27	M	03/05/1998	Francis	Crush rim of tractor tire
7	40	F	21/07/1989	Khedive	Conveyor belt loading hay bales
8	34	M	05/09/1990	Neudorf	Fell off combine
9	36	M	08/12/1996	Melville	Calf roping thumb avulsion
10	71	M	26/08/1996	Southey	Crush in rock picker
11	32	M	13/08/1998	Moose Jaw	Pulley on combine
12	7	M	24/10/1992	Rocanville	Hoist fell on arm
13	51	M	17/07/1999	Carlyle	Fuel injector diesel engine
14	49	M	28/04/1998	Nokomis	Auger
15	74	M	20/11/1996	Regina	PTO avulsion
16	18	M	25/09/1993	Grenfell	Cultivator and wrench
17	15	M	11/09/1990	Semans	Lowering auger
18	26	M	05/08/1998	Vibank	Punched disobedient cow
19	22	M	17/11/1996	Regina	PTO avulsion
20	18	M	08/05/1995	Bellegarde	Crush changing tire combine
21	50	M	20/01/1989	Fir Mount	Unknown
22	46	M	03/09/1999	Semans	Cut on swather
23	25	M	15/07/1989	Dysart	Fixing tire on semi tractor trailer
24	43	M	09/08/1992	Arcola	Cut on swather
25	46	M	03/05/1999	Colgate	Working on tractor with side grinder, blade exploded
26	44	M	13/02/1999	Benson	Grain cleaner
27	63	M	04/04/1995	Carlyle	Roping a horse, dragged 50 yards avulsing thumb
28	56	M	23/08/1995	Osk Bluff, MB	Metal rod crushed finger designing farm machinery
29	45	M	23/01/1995	Strasburg	Radial arm saw
30	26	F	29/12/1997	Rockglen	Kicked by horse
31	67	M	05/10/1993	Imperial	Combine
32	62	M	12/09/1989	Govan	Caught hand in auger
33	66	M	19/05/1999	Moose Jaw	Rototiller
34	43	M	17/09/1999	Gravelbourg	Auger amputated hand
35	23	M	12/02/1998	Kipling	Crushed by bull
36	15	M	06/02/1993	Edenwold	PTO avulsion
37	49	M	28/11/1996	Yellow Grass	Jacking up tractor, crush
38	20	M	15/06/1995	Raymore	Crushed between tractor hitch and stone picker
39	69	M	21/08/1997	Lafleche	Pulley and belt combine
40	30	M	07/12/1990	Frobisher	Grain auger
41	44	M	11/10/1996	Estevan	Fixing combine, chain and sprocket
42	48	M	17/02/1999	Eyeblow	Auger
43	54	F	20/05/1999	Govan	Changing wheel seeder, crushed hand
44	62	M	14/09/1989	Mikado	Combine sprocket and chain
45	66	M	02/10/1996	Frobisher	Chain and sprocket combine
46	48	M	28/01/1999	Melville	Caught in grain roller
47	59	M	30/09/1999	Weyburn	Cut on swather blade

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**TABLE 1 (continued)**  
**Data for patients referred to Regina Health District for farm-related injuries**

Patient	Age (years)	Sex	Date (day/month/year)	Town	Cause of injury
48	31	M	27/07/1993	Claybank	Hit hand against grain bin
49	57	M	02/06/1998	Morse	Cut with jackknife
50	16	M	02/10/1999	Bethune	PTO
51	22	M	27/08/1990	Ogema	Punched cow
52	16	M	23/07/1992	Fort Qu'Appelle	Crushed in baler
53	57	M	04/01/1994	Leross	PTO
54	68	M	09/01/1997	Kenosee Lake	Kicked by horse
55	43	M	30/07/1996	Shoal Lake, MB	Combine
56	53	M	16/11/1990	Glentworth	PTO
57	30	M	22/04/1990	Truax	Auger
58	49	F	11/08/1996	Lumsden	Post hole auger
59	65	M	26/08/1995	Pilot Butte	Building collapsed in hail and wind storm
60	31	M	07/01/1991	Lestock	Cut on machinery
61	39	M	25/08/1992	Whitewood	Rope avulsion branding cattle
62	34	M	01/10/1993	Lanigan	PTO
63	37	M	19/09/1997	Frontier	PTO caught jacket
64	73	M	20/07/1993	Swift Current	Fell off tractor and run over
65	20	M	12/08/1994	Invermay	Chipping ice off PTO
66	64	M	25/07/1993	Cupar	Swather belt
67	54	M	03/10/1992	Pilot Butte	Auger
68	37	M	18/09/1995	Ogema	Auger gear degloving of skin
69	50	M	16/05/1997	Gull Lake	Hydraulic hose leak and injection
70	29	M	07/08/1991	Ft Qu'Appelle	Post hammer
71	14	M	23/08/1995	Redvers	PTO
72	49	M	10/11/1994	Yellow Grass	Trailer hitch
73	36	M	14/04/1992	Rockglen	Caught in calf puller
74	57	M	09/02/1991	Hudson Bay	Auger
75	39	M	29/08/1998	Minton	Pulley
76	51	M	19/03/1994	Riverhurst	Caught in grain vacuum
77	33	M	25/04/1991	Swift Current	Both hands in auger
78	68	M	13/01/1997	Limerick	Fell with knife in pocket
79	31	M	01/04/1991	Silton	PTO
79	32	M	01/10/1992	Silton	Cut finger butchering goat
80	66	M	27/08/1993	Francis	Swather
81	60	M	21/09/1990	Balcarres	Auger
82	36	M	20/07/1991	Tuxford	Friction burn round baler
83	71	M	30/08/1994	Imperial	Operator turned on swather
84	47	M	27/03/1997	Brownlee	Rope in PTO amputated four fingers
85	59	F	06/09/1996	Moose Jaw	Avulsion in auger
86	70	M	09/03/1990	Foam Lake	V belt on combine
87	56	M	10/01/1990	Montmarte	Baler, similar injury seven years before
88	37	M	03/09/1991	Ogema	Auger
89	51	F	30/04/1994	Wauchope	Tractor chain snapped
90	2	F	07/09/1994	Gravelbourg	Swather blade
91	64	M	29/08/1994	Tyvan	Gear in combine
92	63	M	10/09/1990	Brownlee	Hydraulic pressure injury
93	14	M	26/04/1992	Woodrow	Cultivator
94	31	M	18/12/1996	Rowatt	Snowblower

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**TABLE 1 (continued)**  
**Data for patients referred to Regina Health District for farm-related injuries**

Patient	Age (years)	Sex	Date (day/month/year)	Town	Cause of injury
95	58	M	28/11/1990	Zehner	Auger
96	59	M	30/09/1990	East End	Crush injury combining
97	19	M	17/09/1997	Manor	Baler
98	40	M	15/07/1991	Tyvan	Swather
99	72	M	18/07/1989	Stoughton	Clevis
100	71	M	13/10/1996	Kelso	Auger
101	55	M	10/12/1989	Stoughton	Auger
102	39	M	09/12/1997	Francis	Caught in hydraulic hopper door
103	26	F	12/05/1989	Moose Jaw	Cut on headgate of horse chute
104	18	M	20/01/1993	Redvers	Auger
105	56	M	27/12/1991	Grenfell	Mix mill
106	32	M	23/01/1990	Kipling	Crank on auger
107	12	M	31/12/1994	Cabri	Feed grinding mill
108	53	F	10/02/1991	Lemberg	Potato digger
109	59	M	10/11/1996	McLean	Cleaning combine while running
110	42	M	24/10/1992	Tyvan	Belt and pulley combine
111	15	M	07/02/1998	Bienfait	Kicked by cow

DRUJ Distal radioulnar joint; F Female; M Male; MB Manitoba; PTO Power take-off

**TABLE 2**  
**Number and most common causes of injuries occurring each month**

Month	Total number of injuries	Swather	Power take-off	Combine	Auger
January	10		1		2
February	7		1		2
March	3		1	1	
April	6		1		3
May	7			1	
June	3				1
July	11	2		1	
August	18	3	1	3	
September	17	3	1	2	6
October	13		2	6	2
November	8		3	1	1
December	8				2

**TABLE 3**  
**Most common causes of injuries to parts of the body**

Body part injured	Total number of injuries	Swather	Power take-off	Combine	Auger
Thumb	27	1	7	3	3
Index finger	39	5	1	5	11
Long finger	35	2	1	7	11
Ring finger	34	2	1	8	10
Small finger	23	1	1	8	2
Metacarpal	33		3	5	5
Carpus	14		1	1	2
Forearm	21	2	5	3	1

**TABLE 4**  
**Causes of farm-related injuries**

Cause of injury	Number of injuries
Machinery	94
Livestock	11
Other	7

**TABLE 5**  
**Number of injuries resulting from farm-related machines**

Type of machine	Number of injuries
Auger	20
Combine	15
Power take-off	12
Swather	8

**TABLE 6**  
**Type of injury resulting from machines**

Type of injury	Total number of injuries	Swather	Power take-off	Combine	Auger
Laceration	91	8	11	14	16
Crush	66	1	6	10	15
Avulsion	37		10	3	13
Burn	9		3	3	
Injection	4				

**TABLE 7**  
**Structures injured by machines**

Structure	Total number of injuries	Swather	Power take-off	Combine	Auger
Skin	98	8	11	15	17
Extensor tendon	52	3	6	8	13
Bone	87	4	12	12	19
Flexor tendon	44	6	5	2	12
Artery	44	3	10	3	9
Nerve	55	4	10	5	12
Joint	57	3	10	6	13
Nail	25	1	1	5	7

**TABLE 8**  
**Treatment given for patients' farm-related injuries**

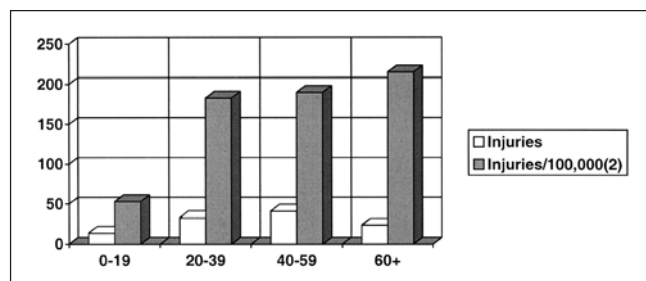
Treatment	Total number of injuries	Swather	Power take-off	Combine	Auger
Repair	95	7	7	14	15
Reconstruction	21	3	7	2	5
Amputation	33	1	7	4	8

**TABLE 9**  
**Associated injuries: nonpower take-off**

Abdominal, changing tractor tire  
Frostbite, caught hand in grain roller for 14 h  
Jejunal perforation, kicked by horse  
Facial, rib and femur fractures, fell off and run over by tractor

**TABLE 10**  
**Associated injuries: power take-off**

C5 quadriplegia, cerebellar infarct, death  
Avulsion right arm at humerus, dislocation left shoulder  
Fractured ribs  
Friction burn to chest



**Figure 2)** Farm-related injuries per 100,000 people according to age (years)

**TABLE 11**  
**Reconstructive procedures performed on patients with farm-related injuries**

Patient	Mechanism	Reconstruction
1	V pulley combine	Skin graft, local flap
6	Crush rim of tractor tire	Revascularization
9	Calf roping thumb avulsion	Replantation failed, groin flap
11	Crush in rock picker	Skin graft
15	PTO avulsion	Local flap FTSG
19	PTO avulsion	Replantation failed, groin flap
23	Fixing tire on semi tractor trailer	Fusion PIP
29	Radial arm saw	Revascularization
45	Chain and sprocket combine	Skin graft
50	PTO	Skin graft
52	Crush in baler	Revascularization
56	PTO	Replantation
57	Auger	Free flap
58	Post hole auger	Free flap
59	Building collapsed in hail and wind storm	Revascularization
60	Cut on machinery	Revascularization
62	Rope avulsion branding cattle	Revascularization
63	PTO	Revascularization
66	Swather belt	Skin graft
67	Auger	Skin graft
68	Auger gear degloving of skin	Skin graft
69	Hydraulic hose leak and injection	Free flap
70	Post hammer	Free flap
71	PTO	Free flap
72	Trailer hitch	Skin graft
73	Caught in calf puller	Skin graft
74	Auger	Revascularization
75	Pulley	Revascularization
76	Caught in grain vacuum	Revascularization
77	Both hands in auger, co-worker started machinery	Revascularization
78	Fell with knife in pocket	Revascularization
80	PTO	Revascularization
82	Friction burn round baler	Groin flap, tendon graft
84	Rope in PTO amputated four fingers	Replantation, skin graft
85	Avulsion in auger	Replantation
87	Baler, similar injury seven years before	Bone grafting
90	Swather blade	Revascularization
94	Snowblower	Revascularization
97	Baler	Revascularization, chest flap
98	Swather	Grafting and flap
102	Caught in hydraulic hopper door	Replantation failed, groin flap
104	Auger	Failed replantation, groin flap

FTSG Free transverse skin graft; PIP Proximal interphalangeal joint; PTO Power take-off



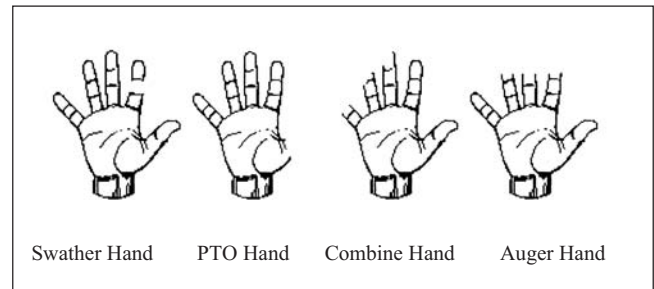
guards that are usually removed to increase the ease of changing implements.

Combine injuries are usually related to the operator catching the ulnar side of his hand in a belt and pulley mechanism. Protective guards have often been removed to ease maintenance. The peak rate of injury in October may be related to hurried operators during a late harvest or perhaps to maintenance issues while getting the combine ready for storage for the winter.

Auger injuries occur throughout the year because farmers haul grain year round. However, there is a peak in August associated with harvest. The longest digits get caught in the turning blades. Fine mesh guards may be removed because they plug easily or do not allow the farmer to place the auger in the grain bin.

We propose a classification of hand injuries relating the pattern of injury to the specific machine that caused the injury (Figure 3).

The present review only looked at in-hospital admissions; however, most injuries are dealt with on an outpatient basis. Despite this limitation, patterns in the timing, scope and cause of injury were found. Farm-related injuries are serious



**Figure 3)** Hand injuries classified according to the location of the injury. PTO Power take-off

and often result in amputation. Prevention is, therefore, the key in trying to decrease disability among farmers. Further study of farmers and their work environment is warranted.

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