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Rising Cases of Motorcycle Wheel Spokes Injuries in A Tertiary Facility in Northern Ghana; A Policy Call

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Learning Point of the Article:

Motorcycle Wheel spoke injuries pose a serious source of complex foot and ankle injuries leading to long-term debilitating deformities. We recommend rigorous public education and awareness creation to forestall the rising trend of these preventable injuries.

Abstract

Introduction: Motorcycle wheel spoke injuries refer to the entrapment of the foot and ankle of a rider or pillion rider into the spokes of a vehicle resulting in varied complex ankle-foot injuries.

Case Reports: We report ten cases of motorcycle wheel spoke injuries between January 1, 2022, to December 31, 2023, majority of whom were children with the youngest being 4 years and the oldest 43 years. A few of the cases sustained both soft tissue injuries and fractures around the ankle while the rest sustained only soft tissue injuries. We believe a lot more of these cases do not get to the tertiary facility for varied reasons.

The mean length of hospital stay was 19±13 days potential indirect negative economic impact on the state, patients, and their family/caregivers.

These injuries can be prevented by developing policies aimed at public education, baring children from riding pillion, and designing protective wheel covering.

Conclusion and Recommendation: Cases of motorcycle wheel spoke injuries are on the rise in the Northern part of Ghana. We recommend public education and awareness creation as well as stringent implementation of road traffic regulations.

Keywords: Wheel spoke, injury, Achilles, Northern Ghana

Introduction

Motorcycle road traffic accidents (MRTA) are a significant contributor of morbidity and mortality in Ghana. A good proportion of the mechanism of motorcycle accidents involves the entrapment of the foot and ankle of riders into the wheel spokes of the motorcycle termed wheel spokes injuries (WSI)[1]. The ascendency of these injuries in some parts of the world has been attributed to inadequate safety protocols and children being the main victims[2].

The spectrum of WSI ranges from minor soft tissue lacerations to extensive crush injury with tendon and bony involvement to subtotal amputations, mainly involving the heel and ankle sites[2].

Few single-centre studies attempted to address the occurrence of motorcycle wheel spokes injuries in both developed and developing nations. Chiang et. al reported that 50% of all injuries in Singapore occur among motorcycle riders and their pillion riders[3]. A similar study in Anambra state, Nigeria found 41.4% of participants sustaining injuries from motorcycle accidents out of which 10.3% had wheel spokes entrapment injuries[4].

These preventable injuries exert enormous pressure on the resources of patients, their immediate families, healthcare

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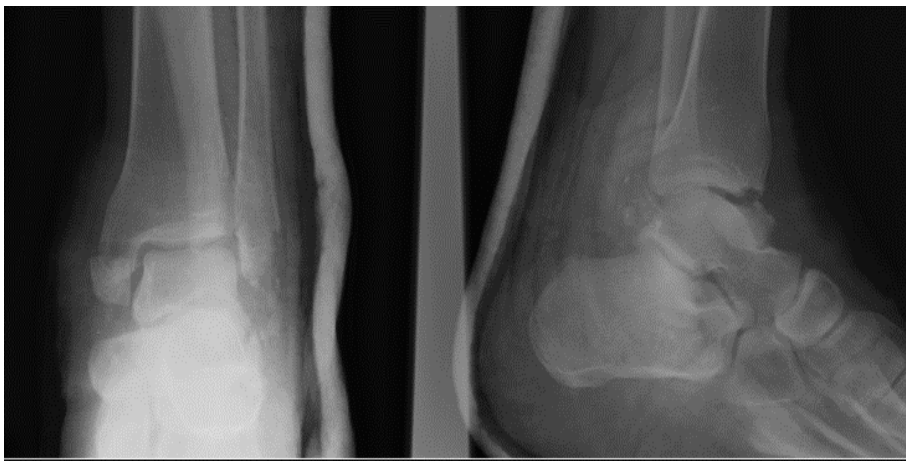

Figure 1: Radiograph of case 1.

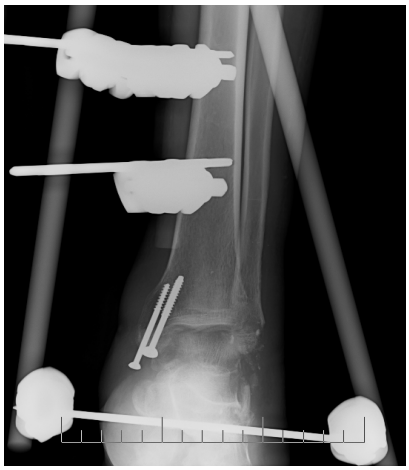

Figure 2: Follow-up anterior-posterior X-ray of case 1.

institutions, and governments. Despite these untoward effects, there is however a paucity of literature about this type of preventable injures caused by motorcycle wheel spokes mostly in developing countries. As a result, this case series is aimed at creating awareness of the increasing number of these injuries and the need for policy orientation on education and preventive strategies to help curb this rising threat in our society.

Case Summaries

Case 1

A 43-year-old male motorcycle rider presented with 8-hour duration of painful deformity at the left ankle with a laceration exposing bony fragments and inability to bear weight. He lost control of his motorcycle while attempting to avoid a head-on collision with an on-coming truck which veered on to his lane and got his left foot and ankle entrapped in the spokes of the front wheel. There was no initial loss of consciousness.

Physical examination revealed a painful deformity of the left ankle with a laceration posteriorly showing exposed bone fragments and a positive Thompson test.

Foot and ankle radiographs revealed a fracture dislocation of the left ankle with bimalleolar fractures (Fig. 1).

Intraoperative assessment showed loss of distal 2cm of the left fibular and a transverse medial malleolar fracture as well as a torn anterior part of the joint capsule. Serial debridement and left ankle spanning external fixation were done with repair of the Achilles tendon. Wound coverage was subsequently achieved with a split-thickness meshed skin grafting.

Follow-up 12 weeks later, showed wound healed completely and fractures united satisfactorily with no equinus deformity, ankle dorsiflexion of 20 degrees from plantigrade position and plantarflexion of 250 from plantigrade position (Fig. 2).

Case 2

An eight-year-old male who was the first of two pillion motorcycle riders en route to school when his left foot got

Figure 3: Clinical photograph of case 2.

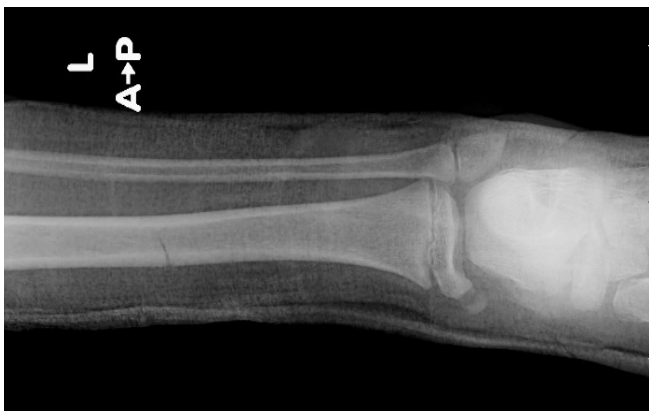

Figure 4: Radiograph of case 3.

Figure 5: Follow-up radiograph of case 3.

Figure 6: Radiograph of case 4.

Figure 7: Clinical picture of case 4 at 1-year follow-up.

trapped in the rear spokes of the motorcycle sustaining an avulsion of the left heel and partial laceration of the left Achilles tendon.

Physical assessment revealed avulsion of the left heel and partial laceration of the left Achilles tendon with a negative Thompson test. Posterior tibialis pulse was not palpable but the dorsalis pedis was palpable and comparable to the contralateral side (Fig. 3).

Wound was debrided serially and 20% laceration of Achilles tendon and wound dressed serially until granulation tissue was healthy and a split-thickness skin graft done.

Patient was nursed 15 days on admission and subsequently discharged. Patient has since not reported back for follow up.

Case 3

A Ten-year-old male who was returning home from school as a pillion rider. His left foot accidentally got trapped into the spokes of the rear wheel of the motorcycle sustaining a laceration at the posterior aspect of the left ankle with exposed tendon fascicles and a painful deformity of the distal leg and inability to bear weight.

On physical assessment, the left foot and ankle were swollen with a laceration of the Achilles tendon. Thompson test was positive. Posterior tibialis and dorsalis pedis pulses were palpable and comparable to the contralateral side.

Radiographs of the left foot, ankle, and tibia showed a greenstick distal tibia fracture (Fig. 4).

The patient underwent serial wound debridement and a delayed primary Achilles tendon repair and wound coverage with split thickness skin graft.

The left foot was immobilized in planter flexion for 3 weeks and serially monitored, manipulated, and immobilized every two weeks till the plantigrade position was achieved.

Follow up at one year after surgery showed that wound healed completely and fractures united satisfactorily (Fig. 5) without equinus deformity, ankle dorsiflexion of 20 degrees from plantigrade and plantarflexion of 35 degrees from plantigrade.

Figure 8: Clinical photograph of case 5.

Figure 9: Clinical picture of case 5 at follow-up.

Case 4

Four-year-old male presented with an avulsion of the posterior aspect of the sole of the left foot. He was the first of two pillion riders en route to a peripheral health facility on account of developing a fever. The motorcycle rider hit a pothole and lost control resulting in the entrapment of the left foot of the patient in the rear spokes of the motorcycle.

Physical assessment

Figure 10: Clinical photograph of case 6.

Figure 11: Clinical photograph of case 7

revealed a partial avulsion of the sole of the left hind foot with a distally placed base. Posterior tibialis pulse was not palpable but the dorsalis pedis was palpable and comparable to the contralateral foot. Thompson's test was positive.

Radiographs of the left foot and ankle showed a fracture of the calcaneus (Fig. 6).

Serial debridement and fixation of the calcaneal fracture with Kirchner wire was done. Wound was serially dressed under sterile conditions till healthy granulation tissue developed. A split thickness skin graft was subsequently done to cover wound.

Follow up at one year revealed a scar tissue at the heel. The ankle had an equinus deformity at 100 from plantigrade, dorsiflexes 100 equinus to 100 and plantarflexes from 100 to 150 (Fig. 7).

Case 5

Nine-year-old male motorcycle pillion rider whose right foot and ankle got trapped in the spokes of the rear wheel. He sustained a laceration at the posterior aspect of the right ankle with exposed tendon fascicles and an inability to plantarflex.

Physical assessment revealed an irregular laceration involving the right Achilles tendon about 3cm from its point of attachment to the calcaneus. Thompson's test was positive. Posterior tibialis and dorsalis pedis pulses were palpable and comparable to the contralateral side (Fig. 8).

Radiographs of the right foot and ankle were unremarkable. The patient underwent serial wound debridement and a delayed primary Achilles tendon repair.

The right foot was immobilized in plantarflexion for 3 weeks and serially monitored, manipulated and immobilized every 2 weeks till the plantigrade position was achieved. Wound coverage was achieved by split thickness skin graft.

Follow up in a year showed a healed wound with minimal scar tissue and the ankle in plantigrade (Fig. 9). There are no functional deficits noted.

Case 6

Seven-year-old female pillion rider of a motorcycle whose right foot and ankle got trapped in the spokes of the rear wheel. She sustained a laceration at the posterolateral aspect of the right ankle with ability to plantarflex.

Physical assessment revealed a laceration involving the left Achilles tendon about 2cm from its point of attachment to the calcaneus. Thompson's test was negative. Posterior tibialis and dorsalis pedis pulses were palpable and comparable to the contralateral side (Fig. 10).

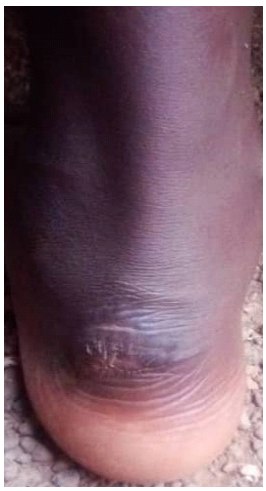

Figure 12: clinical picture of case 7.

Figure 13: Clinical photograph of case 8.

Figure 14: Clinical photograph of case 9.

Figure 15: Clinical photograph of case 10

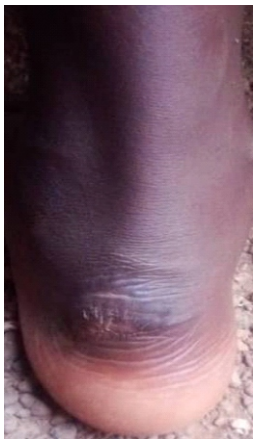

Figure 16: Clinical picture of case 10 at follow-up.

Radiographs of the right foot and ankle were unremarkable.

Patient underwent serial wound debridement and primary wound closure.

Patient was nursed 8 days on admission and subsequently discharged and has since not reported back for follow up.

Case 7

Eleven-year-old female pillion rider of a motorcycle whose left foot and ankle got trapped in the spokes of the rear wheel after hitting a speed ramp. She sustained an avulsion at the posterior aspect of the left ankle with exposed tendon fascicles and an inability to plantarflex.

Physical assessment revealed an irregular partial avulsion involving the left Achilles tendon at posterior part of left ankle with a distally based flap. Thompson test was positive. Posterior tibialis and dorsalis pedis pulses were palpable and comparable to the contralateral side (Fig. 11).

Radiographs of the right foot and ankle were unremarkable.

Patient underwent serial wound debridement and a delayed primary Achilles tendon repair and wound coverage achieved by primary closure

The left foot was immobilized in planter flexion for 3 weeks and serially monitored, manipulated and immobilized every 2 weeks till the plantigrade position was achieved.

Wound satisfactorily healed with no equinus deformity and no functional deficits (Fig. 12) at 12 months follow up.

Case 8

Eight-year-old male who presented with two-hour duration of a laceration at the posterior aspect of the right ankle following an entrapment of his right foot and ankle in the rear spokes of the motorcycle. An irregular transverse laceration involving the Achilles tendon associated with bleeding.

Physical examination showed an irregular laceration involving the right Achilles tendon with a positive Thompson test (Fig. 13). Radiographs of the foot, ankle and distal tibia and fibular were unremarkable.

Serial wound debridement and delayed Achilles tendon repair was done, and wound coverage achieved with a split thickness skin graft. The right foot was immobilized in plantarflexion for 3 weeks and serially monitored, manipulated and immobilized every 2 weeks till the plantigrade position was achieved.

Patient has since not reported back for scheduled follow up reviews.

Case 9

Nine-year-old male appeared well till about an hour prior to presentation when his left foot and ankle got entrapped in the rear spokes of the motorcycle as a pillion rider, sustaining a laceration at the posterior aspect of the left ankle.

Examination showed an irregular laceration involving the left Achilles tendon with a positive Thompson's test (Fig. 14). Radiographs of the foot and ankle were unremarkable.

Serial wound debridement and delayed Achilles tendon repair were carried out and wound coverage achieved with a split thickness skin graft. The left foot was immobilized in planter flexion for 3 weeks and serially monitored, manipulated and immobilized every 2 weeks till the plantigrade position was achieved.

Patient has since not reported back for scheduled follow up reviews.

Case	Age	Sex	Rider type	Laterality	Admission duration
1	43	M	Pillion	Left	46
2	6	M	Pillion	Left	15
3	10	M	Pillion	Left	25
4	4	F	Pillion	Left	38
5	9	F	Pillion	Right	9
6	7	F	Pillion	Right	8
7	11	F	Pillion	Left	23
8	8	M	Pillion	Right	9
9	9	M	Pillion	Left	8
10	7	M	Pillion	Right	13

Table 1: Summary of the clinicopathologic features of cases.

Case 10

Seven-year-old male who sustained a laceration at the posterior aspect of the right ankle following an entrapment of his right foot and ankle in the rear spokes of the motorcycle. An irregular transverse laceration involving the Achilles tendon associated with bleeding.

Physical examination revealed an irregular laceration involving the right Achilles tendon with a positive Thompson's test (Fig. 15). Radiographs of the foot, ankle and distal tibia wound and fibular were unremarkable.

Serial wound debridement and delayed Achilles tendon repair was done, and wound coverage by primary repair. The right foot was immobilized in plantarflexion for 3 weeks and serially monitored, manipulated and immobilized every 2 weeks till the plantigrade position was achieved.

Wound healed satisfactorily at 12 month follow up with no equinus deformity and no functional deficits (Fig. 16).

All the cases should have sufficient follow up and clinical and radiographic pictures of all cases at last follow up.

Discussion

The first documented cases of wheelspoke injuries were reported from October 1976 to February 1978 in which 21 cases were described among pillion riders[5]. Several authors have since reported cases sparsely throughout the world.

Majority [9] of the the cases in our series were children below the age of twelve years with the youngest being 4 years old and the oldest being 43 years (Table 1). This is consistent with the findings of Mak et. al following their retrospective analysis of 24 cases that sustained motorcycle and bicycle spokes injuries[6,7]. Children usually turn to have relatively shorter limbs and, thus may be unable to firmly place their feet on the pillion rider's paddle which results in the limbs either dangling or dislodged into the spokes with minimal jolt.

All the cases in this series were pillion motorcycle riders. Pillion riders may be more predisposed due to the inadequate wheel protective covering and the relatively low anticipation of a possible jolt due to their position on the motorcycle. This is in variance with the findings of Chiang et. al who concluded that there was no difference in the occurrence of the injuries between riders and pillion riders[3].

The foot, ankle, and distal aspect of the leg are liable to injury in wheel spokes injuries. All cases in this series sustained injuries limited to the foot, ankle, and distal aspect of the leg with the left being the side commonly affected. We attribute the limited scope of these injuries to the low-energy nature of the mechanism of trauma. Several previous studies found similar patterns of injuries around the foot and ankle[7-10]. One of the cases in our series sustained a calcaneal fracture, one had a greenstick distal tibia fracture, one sustained a fracture dislocation of the left ankle, and the rest sustained various degrees of soft tissue injuries comparable to a single center study in Labore, Pakistan in which about 6% of participants sustained an additional bone injury[1]. All patients had limb salvage procedures including serial debridement, Achilles tendon repair, ankle spaning external fixation and split thickness skin grafts.

Mean length of hospital stay in our series was 19±13 days with the shortest being 8 days and the longest being 46 days (Table 1) which was similar to the findings of Ahmed et. al and Mak et. al in which 42.5 days and 18.4 days length of hospital stay was found respectively[1,6]. Adult patients forfeit their productive activities within the period of admission, thus affecting household income and may worsen the economic status of families. All paediatric cases in this series drew assistance from family caregivers such as parents, siblings, and friends while receiving treatment. This has the capacity to tip about 5% of families into bankruptcy[11]. The situation could be bigger than it appears since most of the cases probably do not come to the tertiary facility for treatment except the severe cases.

Conclusion and Recommendation

Motorcycle wheel spokes injuries are becoming frequent with varied complex ankle and foot involvement. These injuries can readily be prevented by including adequate protective covering of the rear wheel of motorcycles and legislation barring children from riding pillion and increasing public awareness about these injuries and how to prevent them.

Clinical Message

Wheel spoke injuries are on the ascendency in the Northern part of Ghana and frequently resulting in complex foot and ankle injuries and ultimately debilitating deformities requiring the expertise of a multidisciplinary team comprising orthopaedic, vascular, plastic surgery, radiology, physiotherapy among others for appropriate management of these preventable injuries. Thus, aggressive public health education is urgently required to forestall these injuries by all stakeholders.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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