

# Pattern of Motorbike Spoke wheel injuries in children presenting to the Accident and Emergency Department of a Tertiary care hospital.

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Each author of this article fulfilled ALL 4 Criteria of Authorship:

1. Conception and design or acquisition of data, or analysis & interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
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## ABSTRACT

**Objective:** To determine the pattern of motorbike spoke wheel injuries in terms of severity and location in children presenting to the Accident and Emergency Department of our hospital.

**Methods:** We conducted this descriptive study in Accident and Emergency Department Liaquat University Hospital Hyderabad from 23<sup>rd</sup> January 2018 to 23<sup>rd</sup> January 2021. All children with motorbike spoke wheel injuries fulfilling the inclusion criteria were enrolled in this study. The location and severity of injury was noted and classified as per Tscherne and Oestern classification from grade 0 to grade III.

**Results:** The total number of children in our study were 150. The mean age was 8.4±7.1 years. Male children were 111(74%) and female 39(26%). Right foot was injured in 103(68.66%) and left in 47(31.33%). Grade II injury was documented in 56(37.33%), grade I in 44(29.33%), grade III in 27(18%) and grade 0 in 23(15.33%) children. Heel pad was the commonest area injured in 82(54.66%) children. Tendon ruptures were seen in 14(9.33%) children. Fractures were noted in 12(8%) children. Neurovascular injury was noted in 1(0.66%) child.

**Conclusion:** Motorbike spoke wheel injury had variable pattern of tissue damage and fractures. Most of the children had major soft tissue loss. Heel pad was the commonest injured area. Calcaneus and phalanges fractures were the commonest.

**Keywords:** Motorbike, Spoke wheel, Tscherne and Oestern.

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## INTRODUCTION

Motorbike spoke wheel injuries occur when the foot of the passenger is trapped in the rotating spokes of wheel of a motorbike.<sup>1</sup> The first description of bicycle Spoke wheel injuries was given by Riess<sup>2</sup> in 1948 while Ahmad<sup>3</sup> described motorbike spoke wheel injuries in 1978. Children of 5 to 10 years old are more prone to motorbike spoke wheel injuries and a prevalence rate of 10.3% had been reported in Nigeria<sup>4</sup> and an incidence rate of 21.7% in Lahore.<sup>5</sup> Motorbikes are frequently used by poor parents to drop their children to school as they can not afford school bus service or private car for transportation. Children feet are often dangling near spoke wheels

because they can not reach the footrest of motorbike due to their smaller size thus prone to entrapment in the spoke wheels.<sup>4</sup> The occurrence of Spoke wheel injuries are exacerbated by multi passengers on single motorbike and bumpy roads.<sup>6</sup> The severity of motorbike spoke wheel injuries varies from foot abrasions, laceration and fractures to traumatic foot amputation.<sup>4,5,7,8</sup> The initial presentation of motorbike spoke wheel injuries however can deceive the treating surgeon as most of these injuries may look like mild in the first look.<sup>9</sup> The most susceptible part of the foot injury is the heel and the treatment is very challenging because of the complex nature of the injury usually involving skin, tendons and bones.<sup>6</sup> Although there is no universally accepted

classification for motorbike spoke wheel injuries,<sup>10</sup> Tscherne and Oestern classification<sup>11</sup> is preferred by many authors. In this classification injuries are graded as closed soft tissue injury with contusion,(grade 0), minor bruises and lacerations (grade I), major soft tissue loss(grade II), tendon rupture, neurovascular injury and fractures(grade III).

The objective of our study was to determine the pattern of motorbike spoke wheel injuries in terms of severity and location in children presenting to the Accident and Emergency Department of our hospital. By determining the exact injury pattern management would be more easy and effective and standard treatment protocols can be made.

## METHODS

This descriptive study was conducted in Accident and Emergency Department Liaquat University Hospital Hyderabad from 23<sup>rd</sup> January 2018 to 23<sup>rd</sup> January 2021.Children of either gender and age with foot injury due to motorbike spoke wheels as passengers and presenting within 3 days of sustaining the injury were included. Foot injuries due to fall, accidents and children of poly trauma with other associate injuries requiring surgical interventions were excluded. The study was approved by the Ethical Committee of our hospital. Informed written consent was taken from parents of the children for treatment and participation in this study and publication of our results. All the enrolled children were assessed and resuscitated as per ATLS protocol. Complete history and physical examination was done and relevant investigations(laboratory investigations and radiographs) were ordered. The motorbike spook wheel injury was assessed for its location and

classified as per Tscherne and Oestern classification.<sup>11</sup>

Data was entered in SPSS version 25. Quantitative variables like age and time since injury were presented as mean and standard deviation. Qualitative variables like gender and side of injury were presented as frequency and percentage. Data was presented in table where necessary.

## RESULTS

We included 150 children with motorbike spoke wheel injuries. The mean age was 8.4±7.1 years(range 4 to 12 years).Male children were 111(74%) and female 39(26%).Right foot was injured in 103(68.66%) and left in 47(31.33%). Majority (73.33,n=110 ) of the children were received in 4.2±5 (range 1 to 9 hours) of sustaining the injury. The peak hours of presentation were 7 to 9AM and 2 to 4 PM and majority(56.66%.n=85) of children sustained these injuries Monday. Most(37.33%, n=56) of the victims had Grade II injury as shown in table I. Heel pad was the commonest area injured in 82(54.66%) children followed by dorsum of the foot (30.66%, n=46). Achilles tendon was ruptured in 9(6%) children, extensor tendons in 03(2%) and flexor tendons in 2(1.33%) children. Calcaneus and phalanges fractures were noted in 3(2%) children each. Metatarsal fracture, talus fracture, medial malleolus fracture, lateral malleolus fracture, distal tibia and distal fibula was fractured in 1(0.66% ) child each. One child had posterior tibial artery and nerve transection. All the children were managed accordingly by dedicated team of Orthopaedic surgeons and plastic surgeon.

**Table I:** Severity and location of spoke wheel injuries in children.

Variable	Tscherne and Oestern classification									
	Grade 0 (n=23)		Grade I (n=44)		Grade II (n=56)		Grade III (n=27)		Total	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Male	15	10%	33	22%	47	31,33%	16	10.66%	111	74%
Female	08	5.33%	11	7.33%	09	6%	11	7.33%	39	26%
Right foot	14	9.33%	28	18.66%	43	28.66%	18	12%	103	68.66%
Left foot	09	6%	16	10.66%	13	8.66%	09	6%	47	31.33%
Dorsum of foot	11	7.33%	09	6%	16	10.66%	10	6.66%	46	30.66%
Plantar surface	02	1.33%	01	0.66%	12	8%	07	4.66%	22	14.66%
Heel	07	4.66%	09	6%	38	25.33%	28	18.66%	82	54.66%

## DISCUSSION

When we searched the literature we found that spoke wheel injuries due to bicycle and motorbike

were studied together by many previous authors<sup>12,13</sup> but Zhu<sup>6</sup> believed that motorbike spoke wheel injuries had different mechanism and severity than

those of bicycle and must be studied separately. We agreed Zhu and conducted this study on paediatric motor bike spoke wheel injuries. Furthermore since motorbike spoke wheel injuries are more common in some African countries, <sup>4,8</sup> India,<sup>12</sup> Pakistan<sup>14</sup> and Thailand<sup>15</sup> we could not find sufficient studies from developed countries.

In our study grade II injury was the predominant type of spoke wheel injury noted in 56(37.33%) children followed by grade I in 44(29.33%), grade III in 27(18%) and grade 0 in 23(15.33%) children. Agu<sup>4</sup> evaluated 71 children of motorbike injuries with mean age 6.2 years and noted grade I injuries in 8(11.26%) children, grade II in 20(28.16%) and grade III in 43(60.56%) children. Naumeri<sup>5</sup> shared the record of 120 children with mean age 8.03 years and noted grade I injuries in 10(8.3%), grade II in 55(45.8%) and grade III in 55(45.8%). Spoke wheel injuries were caused by back wheel in 112(93.3%) children and front wheel in 8(6.7%) children in his study. In our study however all the injuries were caused by back wheels. Suri<sup>9</sup> assessed the record of 42 children with mean age 14.9 years. Suri used his own classification and divided the spoke wheel injuries into three classes. Class I injuries included avulsion of minor degree and noted in 7 children. Class II injuries were avulsion of the heel which were extensive but without exposure of tendons and bones and documented in 17 children. Class III injuries involved avulsion of heel with exposed tendons, bones and vessel damage present in 18 children. Suri found his classification best suited for Indian population but critics<sup>4</sup> are of the opinion that that this classification had not included fractures which can occur with spoke wheel injuries. Ayouba<sup>10</sup> noted grade II injuries in 15(58%) and grade III in 11(42%) children with mean age 16 years. Achilles tendon was involved in 17(65%) patients. In our study Achilles tendon was found ruptured in 9(6%) children.

In our study spoke wheel injuries were unilateral and primarily affected the right foot of boys. This findings was in accordance with other studies.<sup>5,6,9,10</sup> Although we could not analyzed the detailed description of the mechanism of motor bike spoke wheel injuries in our series but we proposed that chain guards on the left side protected the left foot. In our study heel was the most commonly affected area in majority(54.66%,n=54) children .Naumeri<sup>5</sup> reported hindfoot involvement in 84(70%) children and Zhu<sup>6</sup> documented that 89(64%) children had heel injuries. Zhu had proposed four-grade treatment based classification for motorbike spoke wheel

injuries in his study. In grade I Achilles tendon was exposed but not cut and was treated with flap transfer. In grade II the ruptured Achilles tendon was repaired and coverage was achieved with flap. In grade III injuries associated calcaneus fractures were stabilized. In grade IV the mangled foot needed amputation. We had noted that the peak hours of sustaining these injuries were 7AM to 9AM and 2PM to 4 PM and majority(56.66%.n=85) of children sustained these injuries on Monday. We assumed that these timings correlates with school timings of children when parents dropped and picked their children from school on motor bike. Similar findings were reported by Suri.<sup>9</sup>

Das<sup>16</sup> was of the opinion that lack of shoes were the main cause of motorbike spoke wheel injuries in his study. This was in contrast to our study and Zhu<sup>6</sup> study as all the children had proper shoes and no child was bare footed in our study while in Zhu series of 89 children only one child was bare footed. In one local study of 92 children with mean age 3.9 years Safdar CA<sup>17</sup> documented bicycle spoke wheel injuries in 80(86.95%) children and motor bike in 10( 10.86%).Motor bike injuries were type III injuries. This author noted an obvious pattern of mechanism of spoke wheel injuries. Front wheel injuries involved the dorsum and medial aspect of the foot while rear wheel injured lateral and posterior aspect of the foot.

## CONCLUSION

Motorbike spoke wheel injury had variable pattern of tissue damage and fractures. Most of the children had major soft tissue loss. Heel pad was the commonest injured area. Calcaneus and phalanges fractures were the commonest. We recommend thorough local assessment of all children with motorbike spoke wheel injuries and cases with deceptive appearances should not be treated as minor injuries and must be admitted. Strict legislation regarding proper use of motor bike, age restriction for child passengers and wearing protective shoes should be mandatory. Improvement in the design of motorbike with adequate spoke guards or shields on both sides and adjustable footrest to prevent hanging feet can decrease the frequency and severity of motorbike spoke wheel injuries in our country.

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