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Epidemiology of motorcycle spinal injuries

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ABSTRACT

Background: 1.2 million people die in traffic accidents every year. Motorcycle accidents account for a large proportion of these road accidents. They are responsible for serious and severe trauma. Most of these victims live in developing countries.

Objective: To study the epidemiologic, clinical, therapeutic and progressive characteristics of spinal trauma caused by motorcycle accidents. **Materials and methods**: This prospective descriptive study was conducted in the Emergency Department and Neurosurgery Department over a period of 18 months. A pre-designed survey form was completed after the interview and physical examination of the patients. Male and female patients of any age treated for spinal trauma after a motorcycle accident were included. Patients who had undergone diagnostic radiologic imaging and regular follow-up for at least one month. The epidemiological, diagnostic, and therapeutic data were studied. **Results**: Spine trauma due to motorcycle accidents accounted for 5.7% of hospital admissions. The male was predominant with a sex ratio of 5.4. The mean age was 27.3 years. The socio-professional strata involved were workers (18.6%), farmers (16.3%) and apprentice motorcycle mechanics. The trauma was caused by a motorcycle skid in 34.9%, followed by a collision between two motorcyclists in 28.7%. Spinal pain was present in all patients, motor deficit in 75.2%, sensory deficit in 60.5%, and sphincter deficit in 48.8%. The thoracolumbar junction was involved in 36.4% of cases, followed by the cervical spine in 30.2% and the lumbar spine in 21.7%. The most common injuries were dislocation fractures (43.4%) and vertebral fractures. In the thoracic, thoracolumbar hinge and lumbar spine, surgery consisted of laminectomy combined with pedicle screw osteosynthesis. At 3-month follow-up, motor deficits persisted in 78.6% and clinical signs improved in 21.4%. **Conclusion**: Spinal trauma from a motorcycle accident is a real and evolving scourge. The emphasis must be placed on prevention. This requires rigorous application of the road traffic.

Keywords
dislocation, fracture, motorcycle accident, neurological deficit, spine trauma

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INTRODUCTION

Road traffic accidents are a major cause of disability and death worldwide. According to the World Health Organization, 1.2 million people die every year because of road accidents; up to 50 million

suffer non-fatal injuries (32). What's more, 90% of these victims are in developing countries (1). In recent years, the motorcycle has become one of the most used means of transport; this for several reasons; in sub-Saharan Africa because of its cost compared to the car, the economy in terms of fuel and speed due to an underdeveloped and poorly maintained road infrastructure. In other countries, two-wheeled vehicles are used to optimize the use of the road network and for ecological reasons because of its low carbon dioxide emissions (16*)*. It is well known that motorcycle accidents account for a large proportion of these road accidents.

They are responsible for serious and severe trauma (1), most often to the skull (7, 19). Spinal injuries resulting from these traumas are rarely reported in the literature. Spinal cord injuries occur more frequently in car occupants in developed countries, unlike in developing countries like Malaysia where motorcycles are most commonly used (27). The rarity of spinal injuries in motorcycle injuries should not be overlooked because of their seriousness; they can be responsible for serious and permanent disabilities or even death (33). Selon certains auteurs les statistiques globales sur l'incidence déclarée des traumatismes médullaires liés aux motos sont peut-être sous-estimées, car de nombreuses victimes d'accidents ne survivent pas et leur décès est attribué à des blessures mortelles visibles plus prononcées, telles que des traumatismes crâniens (23).

Over the last decade in Mali, there has been an unprecedented increase in the number of motorcycle accident victims with spinal injuries. The uncontrolled increase in the number of motorcycles on the road, incivism and dilapidated road infrastructure have a lot to do with it. Lack of awareness of spinal injuries secondary to motorcycle accidents was responsible for poor patient management.

This new phenomenon, for which the departments were unprepared, raised a number of questions, including the mechanisms by which these injuries occur, the types of people affected, the motorcycles involved and the extent of spinal and extra-spinal injuries. The search for answers made it possible to initiate this work, the objectives of which were to establish the frequency of spinal trauma from motorcycle accidents; to describe the mechanisms of the accident; to report the clinical picture of the patients and to describe the spinal lesions found on medical imaging and finally to discuss the therapeutic aspects as well as the post-therapeutic evolution.

Materials and methods

It was a prospective descriptive study conducted in the emergency department and neurosurgery department (consultation room and hospitalization) of the Gabriel Touré University Hospital in Bamako, Mali. The study was carried out over an 18-month period from January 2022 to June 2023. For a better recruitment of cases, a pre-established survey form was filled in dynamically after the interrogation and physical examination of the patients. Screening for inclusion in the study was based on the selection of cases according to a number of criteria, as follows:

Inclusion criteria

Consenting patients of either sex and of any age, treated for spinal trauma following a motorcycle accident during the survey period, were included in the study. Patients who had undergone diagnostic radiological imaging (computed tomography and/or magnetic resonance imaging) of the spine; those for whom an indication for surgery had been given; and those who had undergone regular follow-up for at least one month were included.

Non-inclusion criteria

Patients for whom consent could not be obtained (refusal of patient or legal guardian for children); patients who had not undergone any diagnostic imaging; cases of pathological fractures; cases of spinal trauma with a mechanism other than a motorcycle accident; patients who had not undergone any follow-up consultation after discharge from hospital; former patients with vertebro-medullary trauma of any mechanism were not included.

Quantitative and qualitative variables were used. The parameters studied included the age, sex, and occupation of the patients; the mechanisms of trauma occurrence, the types of motorcycle involved, clinical and radiological signs (CT scan), treatments (medical and surgical), and patient outcome. Data were extracted from our survey form, the emergency department consultation register, the neurosurgery department consultation and hospitalization register, and the operating room report book.

RESULTS

During the 18-month study period, 2239 patients underwent neurosurgery, including 1693 cases of traumatic pathology. One hundred and twenty-nine cases of spinal trauma due to motorcycle accidents were recorded. This represented 5.7% of hospital admissions and 7.6% of all traumatic pathologies. Over an 18-month period, this represents 6.6 cases per month. Males predominated with 84.5% (n=109), giving a sex ratio of 5.4. The average age of patients was 27.3 years, with extremes of 12 and 66 years. The condition affected almost all socio-professional strata, with a predominance of low-income earners. They were blue-collar workers (18.6%), farmers (peasant) (16.3%) and apprentice motorcycle mechanics (13.9%). Table I shows the breakdown of victims by occupation.

Table 1. Distribution of victims by profession

Profession	Number	Frequency (%)
worker	24	18,6
peasant	21	16,3
apprentice motorcycle mechanic	18	13,9
Gold digger	16	12,4
student	15	11,6
itinerant merchant	13	10,1
Motorcycle taxi driver, ,	9	6,9
trader	7	5,4
unemployed	6	4,6

The victims were mainly motorcycle drivers (45.7%), passengers (24%) and other motorcyclists (16.3%). Figure 1 shows the distribution of victims according to their activities at the time of the accident. Trauma was caused by a motorcycle skid in 34.9% (n=45), followed by a collision between two motorcyclists in 28.7% (n=37), and a collision between a motorcycle and a car in 13.9% (n=18). In 15 cases, a pedestrian was hit by a motorcyclist (11.6%). A collision between a motorcyclist and a truck was observed in 8.5% of cases (n=11), and finally, an accident between a motorcycle and a bicycle was observed in three patients (2.3%). Several types of motorcycle were involved in the accident. They were mainly KTM motorcycles, commonly known in Mali as "Djacarta", with 72.1%, followed by Dragon/Haojue with 25.6% and Boxer with 20.1%. Table II shows the different motorcycles involved in the trauma, together with their cylinder gauges.

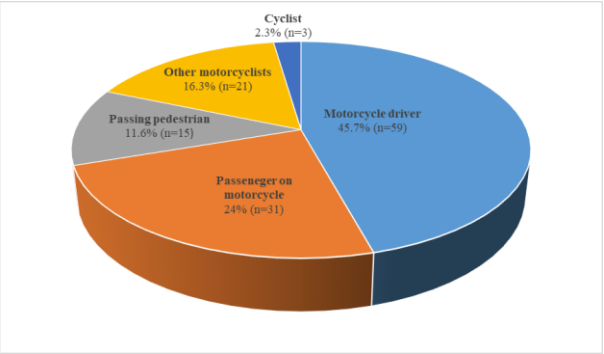

Figure 1. Distribution of patients according to their activities at the time of the accident

Table 2. Distribution of patients by type of motorcycle involved in trauma

Type of motorcycle	Cylinder	Number	Frequency (%)
KTM "Djacarta"	110 cm^3	39	72,1
Dragon/Haojue	150 cm^3	33	25,6
Boxer	125 cm^3	26	20,1
Sanili	150 cm^3	21	16,3
Type not specified	-	7	5,4
Motor GP	1200 cm^3	4	3,1

Clinically, spinal pain was present in all patients, followed by motor deficit in 75.2% of cases, sensory disorders such as hypoesthesia or anesthesia in 60.5% of cases, and urinary and anal sphincter disorders in 48.8%. These included urinary and anal incontinence, urinary and/or fecal retention or mictional imperiousness. Thirty-two patients (24.8%) had no sensory or motor deficits. Full clinical details are given in Table III. In terms of lesion topography, the thoraco-lumbar hinge was the most affected, with 36.4% (n=47), followed by the cervical spine with 30.2% (n=39), the lumbar spine with 21.7% (n=28) and finally the thoracic spine with 11.6% (n=15). Associated injuries affected 58 patients (44.9%).

These were mainly head injuries (24%, n=31), followed by limb injuries (17.8%, n=23). The lower limbs were the most affected, accounting for 69.5%.

Table 3. Distribution of patients according to clinical signs found

Clinical signs	Number	Frequency (%)
Spinal pain	129	100
Spinal deformity	48	37,2
Motor deficit	97	75,2
tetraplegia	16	12,4
tetraparesis	9	7
brachial diplegia	2	1,5
paraplegia	45	35
paraparesis	23	17,8
crural monoplegia	1	0,7
Sensory disorders	78	60,5
Sphincter disorders	63	48,8
urinary and anal	45	35
urinary	11	8,5
anal	7	5,4
No deficit	32	24,8

Trauma to the pelvis and abdomen accounted for 1.5% of cases each, with two patients affected. As far as radiological examinations were concerned, CT-scan scans of the spine, most often centered on the affected spinal segment, were the most frequently performed. In 105 patients, 81.4% of cases were diagnosed by CT-scan alone. It was combined with magnetic resonance imaging (MRI) to make the diagnosis in 16.3% of cases (21 patients). MRI alone was requested for diagnosis in 3 patients (3.2%). These examinations revealed bone lesions compressing nerve structures, responsible for most neurological disorders. The main lesions found were dislocation fractures (43.4%), followed by vertebral fractures (29.5%) and dislocation (17.8%).

Table 4. Distribution of patients according to lesions found on radiology

Radiological lesions	Number	Frequency (%)
Cervical spine	**39**	**30,2**
fracture-dislocation	11	8,5
dislocation	9	6,9
dislocation with hooking	7	5,4
severe sprain	4	3,1
Thoracic spine	**15**	**11,6**
compression fracture	11	8,5
fracture dislocation	4	3,1
Thoraco-lumbar hinge	**47**	**36,4**
fracture-dislocation	34	26,3
compression fracture	9	6,9
dislocation	4	3,1
Lumbar spine	**28**	**21,7**
compression fracture	18	13,9
Fracture-dislocation	7	5,4
dislocation	3	2,3

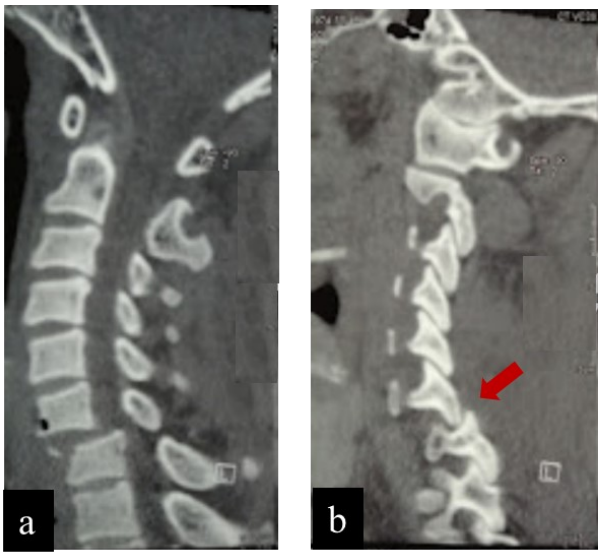

Figure 2. Cervical Spine Trauma
a. C6-C7 dislocation
b. dislocation with posterior joint hooking (the arrow)

Cervical dislocation with joint impingement was present in 5.4% (Figure 2a, 2b). Involvement of the thoraco-lumbar hinge was the most frequent, with fracture-cracking and kyphosis (Figure 3b, 3c). The distribution of radiological lesions found in patients with spinal trauma is shown in Table IV. All patients were treated with medication. Treatment was based on the administration of analgesics. A combination of tier I and II analgesics was administered in 86 patients (66.7% of cases). Morphine was prescribed in 43 patients (33.3%). In addition to analgesics,

patients were also given anti-inflammatory drugs. Non-steroidal anti-inflammatory drugs were prescribed in 34.1% of patients (n=44) and corticosteroids in 65.9% (n=85). Surgery was indicated in all patients. Surgery was not performed in 62 patients (48.1%).

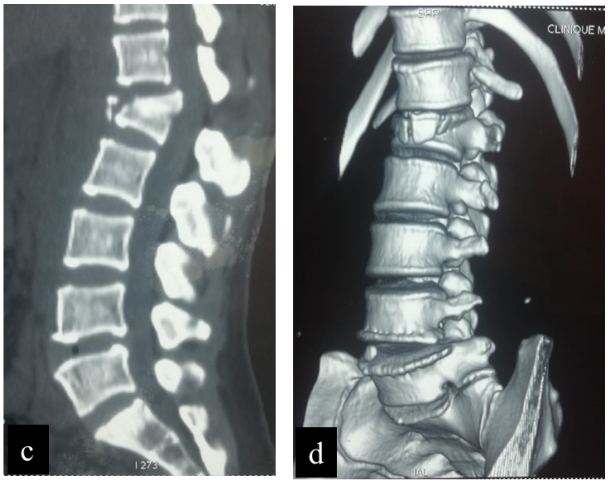

Figure 3. Thoracolumbar hinge trauma
c. L1 compression fracture with posterior wall recession and kyphosis
d. L1 vertebral compression fracture

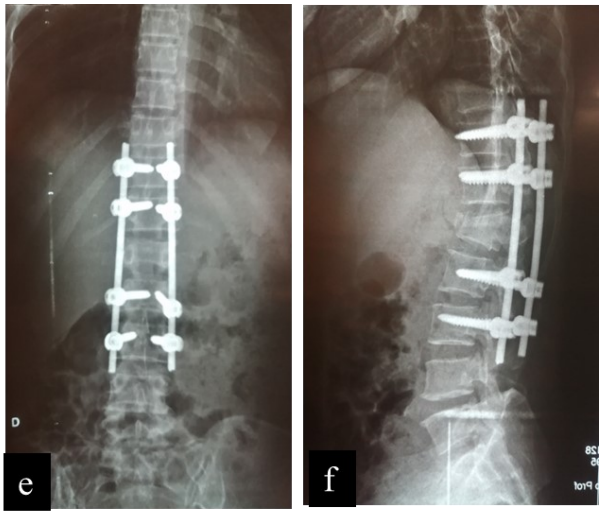

Figure 4. Thoracolumbar hinge osteosynthesis
e. Long assembly (frontal x-ray)
f. Two levels above and below the fracture (profile radiograph)

Of these patients, 28 had financial problems (21.7%), 21 were discharged against medical advice (16.2%) and 13 died before surgical treatment (10.1%). Surgery had been performed in 51.9% of patients (n=67). These included 14 patients with cervical spine injuries (20.9%), 7 cases of thoracic spine trauma (10.4%), 31 cases of thoraco-lumbar hinge injuries (46.3%) and 15 cases of lumbar trauma (22.4%). Surgery consisted of laminectomy combined with pedicle screw osteosynthesis at the thoracic, thoraco-lumbar hinge (Figure 3e, 3f) and lumbar spine. An anterior approach (Figure 5g, 5h) and a combined approach (combination of an anterior and posterior approach in the same patient in a single operation) were performed during cervical spine surgery. Details of surgical treatment are given in Table V. All patients underwent functional rehabilitation with motor physiotherapy for the limb affected. Follow-up involved only patients who had undergone surgery. At one month, improvement was noted in 14 patients (21%).

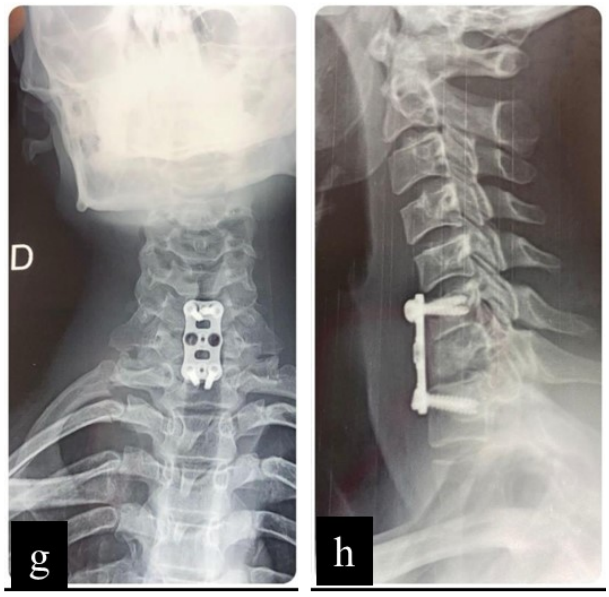

Figure 5. Cervical spine osteosynthesis, anterior approach
g. Plate and screw (frontal x-ray)
h. Plate, screws, and graft (profile radiograph)

These included nine cases of paraparesis, 2 cases of tetraparesis, 2 cases of urinary retention and one case of anal retention manifesting as constipation. In 53 patients, the clinical picture remained unchanged (79%). Postoperative complications involved 17 patients (25.4%), with delayed healing (11 cases) and surgical site infection (6 cases). Thirty-seven patients (55.2%) developed decubitus complications such as bedsore (23 cases) (Figure 6i, 6j), deep-vein thrombosis of the limb (9 cases) and bronchopneumonia (5 cases). At 3 months, eleven patients (16.4%) had been lost to follow-up. Of the remaining 56 patients (83.6%), motor deficits

persisted in 44 (78.6%), sphincter disorders remained in 48 (85.7%), and 20 (35.7%) patients were suffering from pressure sores. The clinical picture improved in 12 patients (21.4%). Forty-eight patients (71.6%) were followed up over a 6-month period. All had sphincter disorders. Forty-four patients had a residual motor deficit (91.6%). Pressure sores were present in 17 patients (35.4%). Four patients showed good clinical improvement (8.3%). Throughout the therapeutic care, no patient received psychological support.

Figure 6. Gluteal Bedsore
i. Beginning stage; j. Advanced phase

Discussion

Socio-epidemiological data

Frequency

In our series, spinal injuries due to motorcycle accidents accounted for 5.7% of hospitalized patients and 7.6% of all traumatic pathologies, i.e. 6.6 cases per month. The frequency of this condition is variously reported in the literature. In the series by (1), it was 13.1% of head trauma patients with initial loss of consciousness and 6.9% of head trauma patients without loss of consciousness. Vasconcelos et al. found in their study that 26% of patients with spinal injuries in the city of Ribeirão Preto were victims of motorcycle accidents (30). This great disparity in the frequency of this condition is mainly due to the patient selection criteria, which differ from one series to another. The low frequency of spinal injuries in motorcycle accidents in our study could be explained by the fact that the work included only trauma victims for whom a surgical indication had been given. This considerably reduces the number of cases. This hospital frequency does not reflect the reality of the country, as it is the result of a monocentric study.

Although spinal injuries are uncommon in motorcycle accidents compared with limb injuries, accounting for between 1% and 11% of all injuries (2, 24, 25), they are likely to be the cause of serious, life-threatening injuries when compared with victims of accidents involving other motorized vehicles (3). This is mainly due to the lack of basic protective equipment among motorcyclists (21). In violent accidents, the motorcyclist's spine is usually affected. Helmets and motorcycle suits offer some protection for the rider. Compared to car drivers, motorcyclists are 30 times more likely to die in a road accident (6). This can have a significant socio-economic impact (21). Overall statistics on the incidence of spinal injuries among motorcyclists are thought to be underestimated, as many accident victims do not survive and their deaths are attributed to more pronounced visible fatal injuries, such as head injuries (13, 23). The incidence of spinal injuries resulting from motorcycle accidents increased fivefold, concomitant with a 4.5-fold increase in the number of motorcycles in the Brazilian state of Bahia between 2000 and 2010 (21). This situation is becoming a real public health problem.

Age

Traumatic pathologies generally affect young subjects, due to their high mobility. In our series, the average age of patients was 27.3 years. The young age of patients involved in motorcycle accidents has been reported by several authors, with a peak between 21(1) and 30 years of age (5, 21, 24). Younger motorcyclists are more confident, sensation seeking need social acceptance and are more impatient than their elders (4, 14, 31). From a neuroscientific point of view, the prefrontal cortex, the part of the brain responsible for thought processes, personality and decision-making, is not yet optimally evolved in young people, leading to risk-taking and daring behavior (10).

Sex

The male predominance described in the literature (1, 5, 21) was found in our study. In Mali, the vast majority of young girls and boys own a motorcycle. Recklessness, constant thrill seeking and incivism

expose boys to road accidents that can result in spinal trauma.

Socio-professional strata

Almost all socio-professional strata were concerned. People with low incomes and low levels of education, notably blue-collar workers (18.6%), farmers (16.3%) and apprentice motorcycle mechanics (13.9%), were the most affected. Intellectual level has a strong impact on a person's decision-making behavior, reasoning and emotional management, which more often than not leads the individual to steer clear of unnecessary risk situations.

Table 5. Location of spinal lesions, type of surgery performed and approach chosen

Location Of Lesions	Number	Approach route		Type of surgery	Frequency (%)
Cervical	14	anterior	8 cases	Discectomy or corporectomy grafting, osteosynthesis	20,9
		combined	4 cases	Laminectomy, Discectomy or corporectomy graft, osteosynthesis	
		posterior	2 cases	Laminectomy, osteosynthesis	
Thoracic	7	posterior	7 cases	Laminectomy, osteosynthesis	10,4
Thoraco-lumbar hinge	31	posterior	31 cases	Laminectomy, osteosynthesis	46,3
Lumbar	15	posterior	15 cases	Laminectomy, osteosynthesis	22,4

Mechanisms of trauma

Trauma occurred after a motorcycle skid in 34.9% of cases, a collision between two motorcyclists in 28.7%, and a collision between a motorcycle and a car in 13.9%. Pedestrians were involved in 11.6% of accidents. In 15 cases, a motorcyclist (11.6%) hit a pedestrian. KTM and Haojue motorcycles were most often involved. The technical characteristics of these machines are not in doubt. They are the most widely used motorcycles in Mali and many other sub-Saharan African countries. They are very fast and not very expensive. This high speed sometimes leads to accidents due to lack of control.

Clinical aspects

Topography of involvement and clinical manifestations

The location of spinal involvement varied from one series to another. Some authors have reported a predominance of involvement of the thoracic spine [8, 10], responsible for vertebral lesions due to hyperflexion (23); others have found that the greatest number of lesions occurred in the cervical (21) or lumbar (8) spine. In our series, most damage was localized to the thoracolumbar hinge (36.4%), followed by the cervical spine (30.2%) and the lumbar spine (21.7%). The thoracic spine is generally more stable due to the rib cage and sternum, so trauma in this region requires more force to cause fractures. With its strong musculature, the lumbar region also appears protected. The thoracolumbar hinge is a transitional zone between thoracic kyphosis and lumbar lordosis, and its lack of muscular coverage means that it is more exposed to traumatic injury. 75.2% of patients in our series had motor deficits. This could be explained by the fact that most of the spinal lesions were located in the medullary zone. Either the spinal injury directly compressed the cord, or the propagation of the shock wave shook the cord. In their study, Tator et al. (*29*) reported that patients with thoracic spine fractures had more complete neurological deficits than those with cervical and lumbar spine fractures (*29*). This finding was not found in other studies, where the highest incidence of neurological deficit was in thoracic spine lesions (21). Fractures of the cervical and thoracic spine are more responsible for neurological deficits, due to the relative natural narrowness of the spinal canal at

these levels (*29*). The violence of the trauma, as highlighted by Alghnam et al (1), could partly explain the extent of spinal injuries and the neurological disorders that accompany them. In their cohort, Oliveira et al. found that most patients had neurological deficits, and more than half were classified as Frankel A or B (21).

Associated injuries

44.9% of the patients in our study had associated lesions, 24% of which were head trauma and 17.8% limb trauma, predominating in the lower limbs. Fouda et al. found head trauma as the main associated lesion in their series (9), whereas Alghnam *et al*. had reported a predominance of limb lesions, followed by those of the skull (1). The head weighs 8 to 10% of the body's weight, and a motorcycle fall while riding will result in acceleration and deceleration, usually ending when the head strikes a surface or blunt object. Isolated spinal injuries accounted for 23.8% of motorcyclists in the Robertson *et al*. cohort (24) and 55.1% in ours. This large difference could be explained by the recruitment method, as the patient selection criteria were different in the two studies.

Radiological investigations

Computed tomography (CT-scan) of the spine, usually centered on the affected spinal segment, was the most frequently performed examination in our study. Due to its availability, affordability and rapidity, CT is the examination of first choice in cases of neurotrauma. It outperforms magnetic resonance imaging (MRI) in the diagnosis of traumatic bone lesions. MRI was requested in cases of neurological disorders without vertebral bone lesions, in search of a severe sprain (usually cervical) or spinal cord contusion. This enabled us to better guide the surgical decision, and to assess the prognosis.

Treatment

The pain that accompanies spinal trauma varies in degree and intensity, depending on the patient's individual susceptibility to the ordeal. This explains the use in our series of analgesics ranging from level I to morphine. The use of corticosteroids in spinal trauma remains controversial. They were administered in 65.9% of our patients. Their action on vasogenic edema, their free radical stabilizing effect and their anti-inflammatory role (26) had justified their use over a short pre- and immediate postoperative period.

With the exception of the cervical spine, where eight patients were treated via an anterior approach and four via a combined approach, all other patients underwent surgery via a posterior approach. This involved decompression of the neurological structures by laminectomy, followed by osteosynthesis using pedicle screws. The aim was to stabilize the spine. Functional rehabilitation with motor physiotherapy was aimed at optimizing the chances of recovery for some, or avoiding severe amyotrophy and ankylosis of the joints, a source of pain. During our study, no patient received psychological treatment. Psychological support is essential in the management of these patients, on the one hand, to help them overcome post-traumatic stress. This can manifest itself through mood swings, anxiety, fear, and insomnia. On the other hand, this treatment will allow for better socio-professional reintegration, especially for patients with neurological sequelae such as disabilities. In Mali, the intervention of psychologists in the hospital sector is not codified. This is due to the lack of appropriate organization of these practitioners and their absence from scientific meetings. This means that the importance of their support is unknown to decision-makers.

Evolution and complications

Operative complications affected 25.4% of patients. They were caused by delayed healing in 64.7% and infection of the surgical site in 35.3% of cases. In their study of 55 patients, Mumtaz et al found 30.9% postoperative complications (18). These consisted of surgical site infection (10.9%), cerebrospinal fluid fistula (3.6%) and delayed healing (1.8%) (18). Emergency surgery in a common operating theater between several surgical specialties could explain the cases of infections recorded postoperatively in our context. Decubitus complications affected 55.2% of patients (Figure 6i, 6j). This is a tragedy in our work context. Nursing, the use of anti-decubitus mattresses, good grooming and physiotherapy constitute the means of prevention. Mortality was 10.1% in our cohort. This result is comparable to that of Robertson et al. who found 10.3% of motorcyclists died because of spinal trauma (24). The management of a patient with neurotrauma is

complex. Multidisciplinary of management can reduce morbidity and mortality.

Prevention

The observation of the increase in cases of spinal trauma linked to motorcycle accidents with its corollary of neurological disorders arouses our concern. This leads us to make some recommendations in the context of prevention. This involves ensuring the application and rigorous compliance with the Highway Code; the development of roadways and the installation of traffic signs; the compulsory wearing of a helmet not only for the prevention of head trauma (main associated injury) but also for the protection of the cervical spine. It has been reported that the helmet plays a protective role for the driver's cervical spine in the event of a motorcycle accident.

In their study covering 5 years of experience including 1061 patients who were victims of motorcycle accidents, Page et al. found a cervical spine injury in 15.4% of motorcyclists without helmets compared to only 7.4% of helmeted motorcyclists ($p < 0.001$; 95% CI) (22). They deduce that there is a link between the absence of wearing a helmet and the occurrence of cervical spine trauma among motorcyclists. This statement is not shared by the main opponents of wearing helmets who, on the contrary, found that wearing helmets would bring an increased risk of injuries to the cervical spine for motorcyclists (12, *28*). According to Moskal *et al.* wearing a helmet does not cause either protective biomechanical effects or harmful effects during an accident (*17*). It is now well established with current data that wearing a helmet does not increase the risk of cervical injuries occurring in motorcyclists in the event of trauma, quite the contrary (11, 15, 20).

Conclusion

The uncontrolled growth of the motorcycle fleet in our large cities has revealed the damage that this machine can cause to the spine. Incivism, the poor state of the roads and the absence of pre-hospital medicine make the motorcycle a very dangerous machine. Observance of the road traffic code and the development of pre-hospital medicine can help reduce the number of victims of spinal trauma caused by motorcycle accidents.

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