



# Acute spinal cord injury in Africa: exploring the long-term outcomes and future directions of acute spinal cord injury – short communication

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## Abstract

Acute spinal cord injury (ASCI), a key factor behind serious sensory, motor, and autonomic dysfunctions, holds on as a fundamental cause of morbidity, psychological disturbances, and high socioeconomic burden. This study sheds light, particularly on the African countries where it is found that traumatic ASCI, mainly due to road traffic accidents, remains the leading cause, with 130 cases per million in this part of the world. Moreover, limited resources, with the lack of funds and equipment, as well as widespread poverty, restrict the availability of suitable diagnostic, management, and treatment options. The weight of the evidence suggests that there is an ultimate need for well-developed infrastructure embracing a multidisciplinary approach to rehabilitation in Africa. Furthermore, international collaborations, posing a significantly wide background for evidence-based information and resources, are indispensable for ASCI prospects and future studies among the African population. The purpose of this study is to fill a part of the persistent gap in the research era regarding the ASCI in Africa and direct future research toward investigating its different aspects as well as exploring its interventional needs.

**Keywords:** Africa, acute spinal cord injury, rehabilitation

## Introduction

Acute spinal cord injury (ASCI) is defined as the sudden onset of damage or trauma to the spinal cord resulting in loss of tissue integrity and impaired function, reduced mobility, or sensory

dysfunction<sup>[1]</sup>. The majority of spinal cord injuries (SCIs) are due to preventable causes such as road traffic crashes, falls, or violence. Up to 90% of these cases are trauma-induced, though the remaining causes such as infection, tumor, degeneration, and vascular lesions tend to be growing<sup>[2,3]</sup>. Symptoms may vary as they depend on the injury's severity and location. Symptoms may include partial or complete loss of sensory function or motor control of arms, legs, and/or body. The most severe SCIs affect bowel or bladder control, breathing, heart rate, and blood pressure. Except for the primary conditions, SCI is associated with a risk of enervating and even life-threatening secondary conditions such as deep vein thrombosis, infections, and respiratory complications<sup>[2]</sup>.

Apart from the physical impairments, ASCI can result in additional tremendous repercussions. Misconceptions, negative attitudes, and decreased morbidity render injured people depressed and exclude them from society. Children with SCI face multiple difficulties in starting and completing school. The financial impact of spinal trauma is also considerable. Many injured people are unemployed and much of the cost is borne by them<sup>[2]</sup>. The high socioeconomic burden is especially high in the low- and middle-income countries (LMICs), where some nations spend over \$2 billion annually, including \$5 million per case of paraplegia and \$9.5 million per case of quadriplegia. In most LMICs, patients also rely excessively on family members for care as rehabilitation services are not sufficient with the survival rates being lower in comparison with the high-income countries (HICs)<sup>[2,4]</sup>. In addition, over 90% of the African population does

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not have access to formal emergency medical services, and pre-hospital care in sub-Saharan Africa and other resource-limited LMICs is poorly defined. Unfortunately, the onward motorization across LMICs will burden the current situation<sup>[5]</sup>. Thus, studying the ASCI in Africa is of utmost importance.

While the annual incidence of traumatic spinal injuries is ~45–80 cases per million worldwide, LMICs experience up to 130 cases per million. Moreover, rates of spinal trauma are 1.6 times higher in LMICs than in HICs<sup>[4]</sup>. In LMICs, road traffic injuries remain the leading cause of traumatic SCI, while infection-related injuries remain prominent in nontraumatic. Males between 15 and 29 and over 65 years are at the highest risk of spinal cord trauma, while a corresponding rise in age is associated with an increased risk of a nontraumatic SCI. Specifically speaking, in South Africa, the SCI epidemiology data is deficient and mostly known in the Western Cape and KwaZulu-Natal provinces. Gauteng Province – the smallest province in South Africa – continues reporting the highest proportion of assault-related traumatic SCI worldwide with the nontraumatic SCI population suffering mostly from HIV and tuberculosis. A wide range of incidence has been published with estimates between 20.0 and 123 injuries per million population with no actual prevalence rates published in Africa<sup>[3]</sup>.

As already mentioned, there is a deficit in prehospital care for traumatic SCI research conducted in LMICs<sup>[5]</sup>. Further epidemiological and outcomes-based research on SCI patients is also needed. Undoubtedly, research will guide policy change by ensuring the best possible care and opportunity for the injured<sup>[3]</sup>.

In this editorial, we aim to describe the situation of acute spinal cord injury in African countries and discuss future directions for relevant research as well as measures that need to be undertaken for the conduction of high-quality tissue-engineering clinical trials for ASCI in Africa.

### **Risk factors, diagnosis, and management of acute spinal cord injury in Africa**

There are multiple traumatic and nontraumatic risk factors for acute spinal cord injury in Africa. Road traffic accidents are the most common cause of acute spinal cord injury in Africa. This is because of poor infrastructure, unsafe vehicles, and practices like transporting people in open lorries<sup>[6]</sup>. A study in Abuja, Nigeria, showed that 60.4% of patients with traumatic spinal cord injury were involved in road traffic accidents. In addition, pedestrians were more likely to sustain spinal cord injury than vehicle users. Furthermore, pedestrians were more likely to die<sup>[7]</sup>.

Research conducted in central Ethiopia revealed that road traffic accidents are primarily attributed to reckless driving and exceeding speed limits. These findings emphasize the necessity for governments to adopt stricter traffic regulations to proactively prevent such accidents<sup>[8]</sup>. However, South Africa has traffic legislation that meets international standards. However, certain driving behaviors and societal norms result in increased accidents. In addition, socioeconomic status compels people to drive for extended periods, further contributing to the problem<sup>[9]</sup>.

Another contributing factor is related to the vehicles themselves. Due to low income, regular maintenance often gets overlooked, resulting in compromised safety standards. Additionally, many African countries rely on second-hand vehicles. These

countries do not have adequate regulations to ensure the safety of the vehicle. These factors contribute to higher accident rates<sup>[10]</sup>.

Moreover, falls, particularly from a height, and violence involving gunshot and stab wounds are significant risk factors<sup>[11]</sup>. A traumatic but rare cause is sports-related injury<sup>[12]</sup>. Pott's disease, which is the tuberculosis of the spine, is responsible for 25% of nontraumatic spinal cord injuries. Additionally, it can cause sudden onset injury by damaging the vertebrae and leading to anterior wedging fractures that compress the spinal cord. Other nontraumatic causes include tumors, HTLV-1 (human T-cell lymphotropic virus type 1), HIV, and syphilis<sup>[13]</sup>.

Many people in Africa suffer from poverty and limited resources. This limits the availability of diagnostics for patients with acute spinal cord injury. Magnetic resonance imaging (MRI) is considered crucial in the diagnosis of spinal cord injuries. Many people cannot afford the cost of an MRI. In addition, this type of imaging is not available in many African regions<sup>[13]</sup>. It is important to adapt to these challenges and develop diagnosis guidelines that consider limited resources.

Management and treatment of acute spinal cord injuries in Africa face many difficulties that prevent providing the appropriate care. A study in Nigeria showed that the majority (54.2%) of patients with spinal cord injuries were transferred to the hospital by car, not ambulance<sup>[14]</sup>. In addition, patients with spinal cord injuries are rarely immobilized before reaching the hospital, which leads to deleterious complications that could be prevented if patients were transferred appropriately<sup>[15]</sup>. Actually, the basic first response to any emergency comes from the mere sole of initiation to help among the present, of whom the majority could be of no medical background<sup>[16]</sup>. On the other hand, the scanty evidence-based reviews of the first-aid guidelines and material that are pertinent to LMICs, results in even low evidence-qualified emergency medical practitioners<sup>[17,18]</sup>. To fill this gap, especially with the growing demand for musculoskeletal care, traditional methods of stabilization through bone setting are used in some African countries<sup>[19,20]</sup>. Moreover, many countries have even gone further, depending primarily on traditional bone setting as a crucial source of health care for multiple reasons, including the paucity of care, poverty, and greater accessibility, according to a study done on the Tanzanian population<sup>[21]</sup>. Stabilization through bone fixation usually utilizes local materials such as wood and animal hide<sup>[21]</sup>. For instance, bones of the spine are stabilized by wrapping the body with animal hide and tying wood parts around to immobilize the body<sup>[21]</sup>. In addition, paddings, made of primitive material such as clothing or pieces of mattress, are placed against the patient's skin<sup>[21]</sup>. Although a previous study showed the importance of early spine stabilization, especially within the first 72 h in a hospital setting, this is not always the case in traditional bone settings done outside the hospital as it leads to serious consequences<sup>[21,22]</sup>.

Furthermore, the paucity of perioperative and ICU care in limited-resource countries is responsible for low improvement rates<sup>[4]</sup>. One important fact is that most patients require surgeries to treat their injuries. There are multiple limitations to the surgical management of spinal cord injuries in African countries. A study of cervical spinal injury patients in East Africa showed that only 24.8% of patients who meet the criteria for surgical management undergo the procedure. This is because of the lack of funds and the lack of equipment in the hospitals<sup>[4]</sup>. Limited resources of health care in African countries result in higher mortality rates of spinal cord injuries compared to the developed countries<sup>[15]</sup>.

Patients with spinal cord injury may need equipment to help them with the activities of daily living. Wheelchairs may not be reliable in certain areas due to unpaved roads. Also, these devices are not affordable for many people<sup>[15]</sup>. There is a need for initiatives that help people overcome these challenges.

It is also crucial to emphasize the significance of training all health workers, including even the lowest-ranked individuals in the health sector, on the administration of first aid, especially in many rural and remote areas of Africa where access to specialized medical facilities may be limited<sup>[23,24]</sup>. Timely and appropriate first-aid interventions can potentially reduce the severity of injuries and improve outcomes for SCI patients, ultimately contributing to better long-term prognosis and quality of life<sup>[24]</sup>.

**Rehabilitation and long-term outcomes of acute spinal cord injury in Africa**

The multidisciplinary approach of rehabilitation, encompassing physical therapy, occupational therapy, and speech therapy, is an effective tool to address functional or communication-related limitations and enhance independence in routine activities of patients with acute SCI<sup>[25,26]</sup>. Through targeted interventions and exercises, rehabilitation helps individuals regain functioning, primarily through the promotion of neuroplasticity, allowing for the potential recovery of lost functions<sup>[27]</sup>. Rehabilitation also provides psychosocial support, addressing emotional and psychological challenges that often accompany SCI<sup>[25,28]</sup>.

Limited resources, including inadequate infrastructure, specialized rehabilitation centers, and trained healthcare professionals, pose significant barriers to effective rehabilitation, particularly in rural areas<sup>[4,29]</sup>. Cultural barriers, driven by stigma and misconceptions surrounding disability also, may result in social isolation and limited community support for

individuals trying to access rehabilitation<sup>[29,30]</sup>. Financial constraints further compound the problem, as many individuals cannot afford the costs associated with rehabilitation services and assistive devices<sup>[31]</sup>. All these and more are the challenges that fraught the access to rehabilitation services in Africa.

The long-term outcomes of acute SCI in Africa have far-reaching implications for patient’s motor function, quality of life, employment prospects, and socioeconomic status including a degenerative effect on motor function, psychological well-being, social integration, and community participation<sup>[30]</sup>. Many individuals with SCI face challenges in returning to work or finding suitable employment opportunities due to physical limitations and societal barriers<sup>[25]</sup>. This, in turn, affects their financial independence and overall socioeconomic well-being<sup>[28]</sup>. Addressing long-term outcomes requires a comprehensive approach that encompasses ongoing rehabilitation, community support, vocational training, and policies promoting inclusive employment opportunities<sup>[31]</sup>.

**Future directions for acute spinal cord injury research in Africa**

In recent years, there has been growing interest in exploring innovative approaches to enhance SCI recovery and functional outcomes. Promising avenues include stem cell transplantation and gene therapy, which hold the potential for regenerating damaged neural tissue and restoring lost functions<sup>[32,33]</sup>. Another is tissue engineering with the aim of developing biomaterials and scaffolds that can support axonal regeneration and create a favorable environment for neuronal regrowth (Fig. 1)<sup>[33]</sup>.

While significant progress has been made in SCI research globally, specific gaps persist in the African context<sup>[3]</sup>. Comprehensive studies are needed to understand the epidemiology and

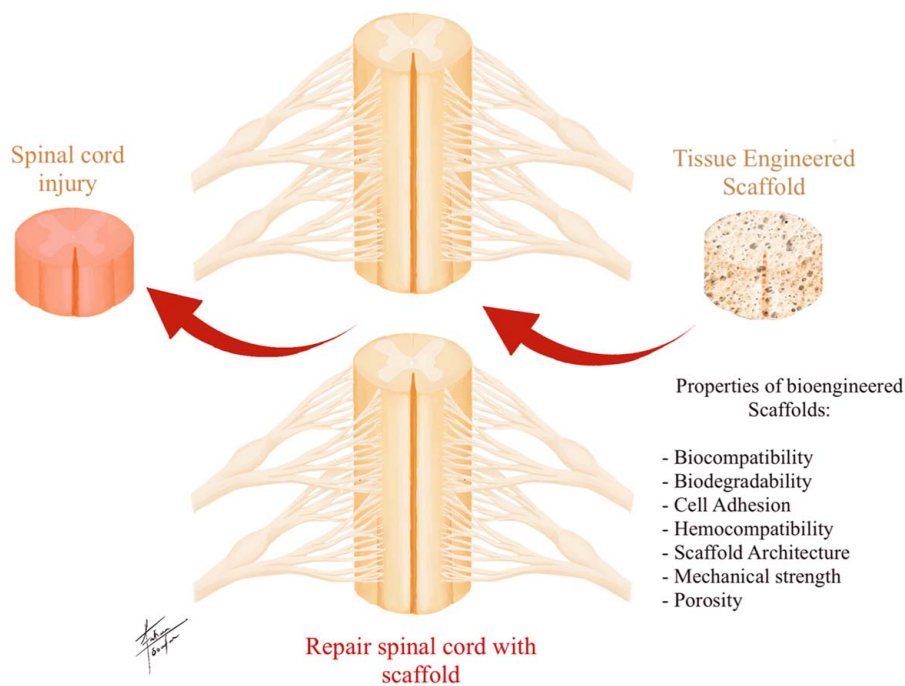


Figure 1. Tissue engineering for acute spinal cord injury.

risk factors, such as road traffic accidents, falls, and violence associated with SCI in African populations<sup>[3,6]</sup>. Investigations into cultural beliefs, access to health care, and socioeconomic disparities can help inform interventions tailored to the African context<sup>[31]</sup>.

Community health workers (CHWs) are well-positioned to offer immediate care and support to individuals who have experienced SCI, often being the first responders in remote areas where medical resources are scarce<sup>[34,35]</sup>. About four African publications have been documented in a scoping review of CHWs contributing significantly to the rehabilitation process by providing ongoing support, education, and advocacy for SCI patients and their families and even more on general community-based rehabilitation exercises<sup>[34]</sup>. Empowering and involving CHWs in SCI care can help bridge the gap between underserved communities and formal healthcare systems<sup>[35]</sup>.

International partnerships enable knowledge exchange, resource sharing, and capacity building. The partners can benefit from each other's diverse perspectives, expertise, and experiences, leading to more robust study designs and implementation<sup>[36,37]</sup>. Collaborations also facilitate the translation of research findings into policy and practice, promoting the integration of evidence-based interventions into healthcare systems<sup>[31,37]</sup>. Establishing research networks, funding initiatives, and joint training programs can foster collaboration and create sustainable platforms for SCI research in Africa<sup>[36]</sup>.

### How to conduct high-quality tissue engineering clinical trials for acute spinal cord injury in Africa

Data on clinical trials studying tissue engineering in acute spinal cord injury are limited. In the study of Skeen *et al.*, SCI patients did not receive any stem cell treatment within South Africa or abroad provided by or recommended by a recognized spinal cord injury treatment center. This kind of treatment for every study participant was also not beneficial. As patients with SCI seem to be willing to undergo nonevidence-based procedures and spend large amounts of money in the belief that they will be cured, ethical concerns are raised. The International Campaign to Cure Spinal Cord Palsy (ICCP) has compiled guidelines to inform patients suffering from SCI about stem cell clinical trials. This statement warns people about the risks of participating in treatments that are not evidence-based in order to protect both the patients and the stem cell research community. Although there is relevant legislation in South Africa, no action has been taken so far against professionals who offer unproven stem cell treatments to patients with SCI. Government authorities and professional organizations should strictly enforce relevant regulations<sup>[38]</sup>.

### Conclusion

With a notable morbidity rate and serious permanent disabilities, ASCI is associated with ruinous consequences, taking a toll on the physical and mental well-being of the individual. Trauma, with a 90% rate, ranks first as the most common cause of ASCI, with a majority of preventable causes, especially traffic accidents in Africa. Not only does it correspond to physical impairments, psychological dysfunctions, and social difficulties, but ASCI also holds a huge financial burden, especially among the African population. With limited resources, funds, and poor medical

infrastructure, Africans are at high risk of developing long-term sequels. For instance, diagnostic tools, management, and treatment requirements – including first aid, preoperative, operative, and postoperative equipment – in addition to rehabilitation services are considered to be insufficient or lacking in many African countries.

Africa, until now, still lacks actual epidemiological studies showing the prevalence rates, although a huge interval is suggested. Therefore, studying the ASCI, with all its aspects, in Africa is indispensable. Both descriptive and nondescriptive studies are essential to investigate the circumstances of ASCI in the African population and can help in the development of preventive strategies. This requires emancipating research in Africa as well as empowering African researchers by enhancing international collaborations. For instance, those relations permit effective evidence-based information exchange and can provide high-level training programs. On the other hand, partnerships allow the sharing of resources and infrastructure with which healthcare practitioners in Africa must be acquainted. Furthermore, new policies and diagnostic criteria must be set to avoid the consequences of insufficient resources and diagnostic tools, and healthcare practitioners need to be highly trained on these policies. Community engagement through awareness campaigns is also of high significance, as social acceptance plays a crucial role in the well-being and independence of the affected individuals.

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O.U.: conceptualization, project administration, writing – review and designing; B.K.B.: conceptualization, writing the first draft, and revising, reviewing, and editing. All authors approved the final manuscript and submission.

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