

Review Article

# A Retrospective Epidemiological Study of Patients Hospitalized with Spinal Cord Injury in Dalian Port Hospital from 2017 to 2019

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**Abstract:** *Background:* spinal cord injury is a common traumatic disease. More than 90% of spinal cord injuries are caused by trauma, such as traffic accidents, violence, physical confrontation, sports, etc. Although spinal cord injury is more common and closely related to our life, it is a difficult project to investigate the epidemiological factors of spinal cord injury. In China, there is a lack of national epidemiological analysis of spinal cord injury, and the epidemiological study of spinal cord injury in different cities in China shows different characteristics. *Objective:* To analyze the clinical characteristics of spinal cord injury and discuss the corresponding treatment. *Method:* Based on various domestic and foreign literatures on spinal cord injury treatment and rehabilitation, a retrospective analysis was conducted on 137 patients with spinal cord injury admitted to Dalian Port Hospital from 2017 to 2019. *Results:* The average age of spinal cord injury was 53.92 years. The ratio of male to female patients was 2.83:1; The number of male patients aged 60-69 (30.30%) and female patients aged over 70 (28.57%) was the largest. The injury site of male spinal cord was the most in the neck (54.6%), female the most in the waist (40.6%), followed by the neck (34.4%). In choice of surgical treatment of patients with cervical spine injury patients most (52%), and anterior surgery (43.1%), followed by posterior (35.4%), and thoracic spinal cord injury without anterior surgery patients, most patients (83.3%), posterior surgery patients with lumbar segment damage up to use the posterior surgery (83.3%), a few patients with anterior surgery (6.7%).

**Keywords:** Spinal Cord Injury, Epidemiology, Analysis

## 1. Introduction

Spinal cord injury (SCI) is a kind of temporary or permanent injury to the spinal cord caused by various factors,

and affects the nerve function of the segment below the level of the injured spinal cord, resulting in motor and sensory dysfunction [1], which makes the main functions of the spinal cord sensory, motor, reflex and other, disorders. According to the degree of injury, spinal cord injury can be divided into

complete spinal cord injury and incomplete spinal cord injury. Complete injury refers to the complete loss of motor and sensory functions below the level of injured spinal cord, while incomplete injury refers to the existence or retention of some motor and sensory functions below the level of injured spinal cord. In general, the spinal cord is in the spinal canal protected by the spine. When the spinal fracture is caused by a large external force, the spinal cord loses its protection and causes different degrees of injury. Therefore, spine injury is the main cause of spinal cord injury. According to clinical data analysis, more than 90% of spinal cord injuries are caused by trauma, such as traffic accidents, external violence, physical confrontation, sports, etc. Therefore, according to the cause of injury, it can be divided into traumatic spinal cord injury and non traumatic spinal cord injury. The traumatic injury is known as primary spinal cord injury, while the non traumatic injury is mainly due to the former or chronic diseases.

Spinal cord injury is a common disease. The incidence rate of spinal cord injury in the world is between 3.6-195.4/106 [2-3]. The nerve roots extending from the spinal cord between the spine can sense the sensory information of the corresponding dermatome area and control the muscle groups controlled by the corresponding myotome area [4]. Therefore, the physical examination method of patients with spinal cord injury is to determine the location of spinal cord injury by examining the sensory plane and motor plane of the patient. In addition, due to the loss of labor force, the high cost of treatment and rehabilitation, as well as the occupation of a large number of medical resources, it has caused a huge burden on patients, families and society. Therefore, the treatment and rehabilitation of spinal cord injury has become a topic that can not be ignored. Although spinal cord injury has attracted wide attention worldwide, it is a difficult project to investigate the incidence rate of spinal cord injury and other epidemiological factors.

In China, there is a lack of national epidemiological analysis of spinal cord injury. However, some epidemiological studies on spinal cord injury in different cities in China, such as Shanghai [5], Guangdong [6], Chongqing [7], show the differences in the incidence and characteristics of spinal cord injury in different cities in China.

Based on a variety of domestic and foreign literature on treatment and rehabilitation of spinal cord injury, this paper retrospectively analyzed the clinical characteristics and treatment methods of 134 patients with spinal cord injury admitted to Dalian Port Hospital from 2017 to 2019, so as to understand the characteristics of spinal cord injury of patients who received postoperative rehabilitation treatment, and provide help for subsequent treatment and rehabilitation.

## 2. Method

### 2.1. Research Method

According to the medical records of our hospital, a total of 134 cases of spinal cord injury admitted to Dalian Port Hospital for rehabilitation treatment from 2017 to 2019 were

statistically analyzed. The statistical contents include: name, gender, age, spinal cord injury site, admission date, opening mode of operation before admission, etc.

### 2.2. General Information

Inclusion criteria: (1) all rehabilitation patients with spinal cord injury admitted to Dalian Port Hospital from January 1, 2017 to December 31, 2019. (2) According to the diagnosis of doctors and instruments, the patient's symptoms are consistent with the clinical symptoms. (3) The patient has a complete medical record, including the date of injury, date of admission and date of discharge, etiology of diagnosis, site of injury, and surgical method.

Research standards: strictly abide by clinical research norms and guidelines: ethics and regulations (3rd Edition) [8], follow the unified norms and guidelines of clinical research, sign privacy confidentiality agreement with patients, and complete clinical trial research with the highest quality.

## 3. Result

### 3.1. Essential Information

According to the statistical results, among the 134 patients with spinal cord injury who received rehabilitation treatment in Dalian Port Hospital from 2017 to 2018, 99 were males and 35 were females. The age distribution of patients with spinal cord injury ranged from 14 to 84 years, with an average age of 53.92 years old. The age distribution of male patients ranged from 14 to 84 years old, with an average age of 53.74 years old. The age distribution of female patients ranged from 22 to 82 years old, with an average age of 54.43 years old.

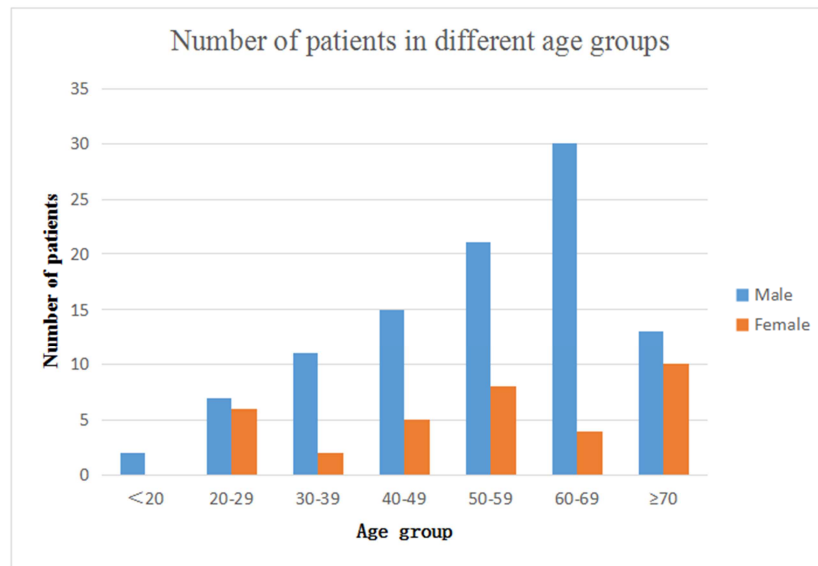
### 3.2. Sex Ratio of Patients with Spinal Cord Injury

Among 134 patients with spinal cord injury from 2017 to 2019, the ratio of male to female was 2.83:1. As shown in Figure 1, the male to female ratio of spinal cord injury patients in 2017 was 2.57:1. In 2018, the male to female ratio was 2.11:1. And in 2019, the male to female ratio was 4.56:1.

### 3.3. The Situation of Patients with Spinal Cord Injury in Different Age Groups

Figure 1 shows that in different age groups, the proportion of male patients with spinal cord injury is higher than that of women. The gender difference of patients with spinal cord injury between 30-39 years old and 60-69 years old is the most significant, and the gender difference of patients with spinal cord injury above 70 years old is small. The number of patients aged from 50 to 59 years old, 60 to 69 years old and over 70 years old was relatively large. The percentage of patients in each three age groups accounted for about 20% of all patients. Among them, the number of male patients increased gradually with the increase of age group, but the number of patients over 70 years old decreased on the contrary. The number of female patients over 70 years old was the largest, followed by 50 to 59 years old and 20 to 29 years old

age group.

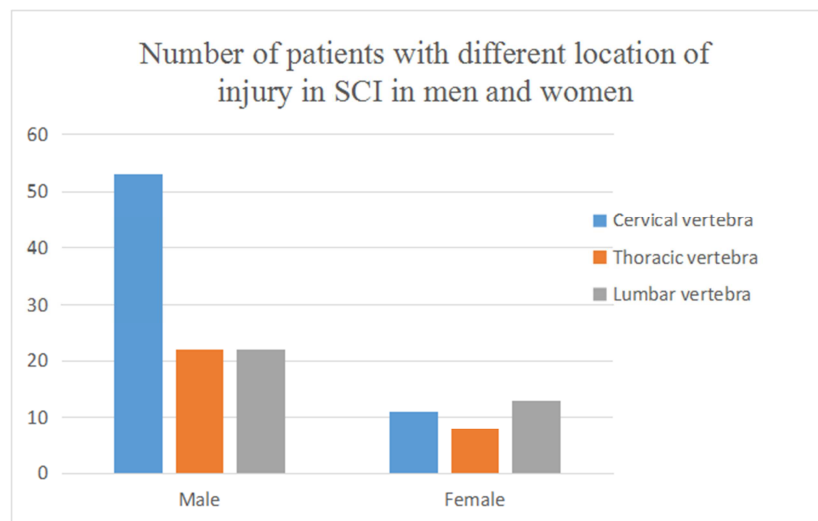


**Figure 1.** This figure shows the number of patients in different age groups. We can find that the number of male patients increases with age, except the number of patients over 70 years old. Female patients do not show the increasing trend as male patients.

### 3.4. Location of Injury in Patients with Spinal Cord Injury

It can be seen from the statistical figure 2 that after excluding the patients with combined spinal cord injury, there are 129 cases of spinal cord injury in men and women, 97 cases in male and 32 cases in female, accounting for 75.2% and 24.8% of the total number of patients respectively. In male patients with spinal cord injury, the number of patients with cervical spine injury was 53, accounting for 54.6% of male

spinal cord patients. There were 22 patients with thoracic and lumbar spine injury, accounting for 22.7% of male patients. In female patients, through statistics found that 32 women with spinal cord injury, less than men. There were 11 patients with the cervical spine, accounting for 34.4% of the female patients, 8 patients with thoracic spine injury, accounting for 25% of the female patients, and 13 patients with lumbar injury, accounting for 40.6%.



**Figure 2.** The number of patients with different location of injury in SCI in men and women show that the majority cases of male patients were cervical injury, while female patients had the most cases of lumbar injury.

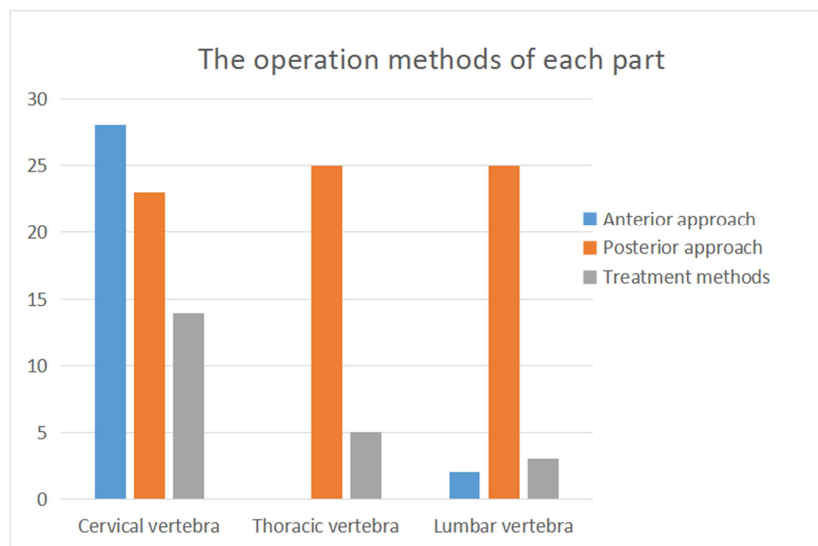
### 3.5. Surgical Methods in Patients with Spinal Cord Injury

According to the statistical data (as shown in Figure 3), among the 125 patients with spinal cord injury who were selected for surgical treatment, 65 patients were operated on the cervical spine, accounting for 52% of the total number. 30

patients were operated on the thoracic spine, accounting for 24% of the total number. And 30 patients were treated at the lumbar spine, accounting for 24%. Among the patients operated on the cervical spine, 28 patients underwent anterior decompression, accounting for 43.1% of the total number of patients undergoing cervical spine surgery. 23 patients

received posterior decompression, accounting for 35.4% of the total number of patients undergoing cervical spine surgery; 14 patients received other treatment methods, accounting for 21.5% of the total number of patients undergoing cervical surgery. In patients operated on thoracic vertebrae, 0,25,5 patients were treated by anterior approach, posterior approach

and other treatment methods, accounting for 0,83.3% and 16.7% respectively. At the lumbar spine surgery group, 2,25,3 patients were treated by anterior approach, posterior approach and other treatment methods, accounting for 6.7%, 83.3% and 10% respectively.



**Figure 3.** This graph shows the statistics of the operation methods of patients undergoing surgical treatment. The anterior approach is basically only used on the cervical spine, while the posterior approach is used in different locations of spine.

## 4. Discussion

### 4.1. Age factors of Spinal Cord Injury

In this retrospective study, the average age of spinal cord injury patients admitted to Dalian Port Hospital for rehabilitation treatment from 2017 to 2019 was 53.92 years old. The average age of patients with spinal cord injury in Guangdong Province from 2011 to 2015 was  $41.5 \pm 12.6$  years [9]. From 1999 to 2016, the average age of patients with spinal cord injury in Tianjin was  $51.6 \pm 15.2$  years [10]. The average age of the patients in this study is consistent with that in other regions of China. From different age groups, the number of male patients with spinal cord injury in less than 20 to 70 years old age groups gradually increases with age, and decreases after 70 years old, while female patients are more prominent in 20-29 years old group, 40-49 years old group and after 70 years old group.

Generally speaking, spinal cord injury is mostly caused by sports injury and external violence injury, such as traffic injury, fall injury and so on. Therefore, spinal cord injury is mostly caused by sports or work-related injuries in young people, so young people are more likely to suffer from spinal cord injury, which is contrary to the result of this study. The possible reasons are as follows: Firstly, Dalian Port Hospital is a rehabilitation hospital. Most of the patients who come to our hospital for rehabilitation treatment are those who have poor rehabilitation effect in the original hospital, have rich family economic conditions, or have bought work-related injury insurance. Therefore, most of them are middle-aged and

elderly patients who have savings and poor rehabilitation effect. Second, with the rapid development of China's economy, the life style and life concept of the elderly have changed. More and more elderly people have given up the traditional idea of avoiding sports and began to participate in outdoor activities, such as morning exercise, square dance, traveling, etc., which leads to the increased risk of spinal cord injury. With the arrival of aging society, the increase of the number of elderly people further leads to the increase of the number of elderly with spinal cord injury. Third, with the growth of age, the human spine gradually degenerates, resulting in secondary spinal stenosis. Compared with patients without spinal stenosis, patients with spinal stenosis are more likely to lead to spinal cord injury after falling.

In some foreign regions, for example, from 1995 to 1999, the average age of patients with spinal cord injury in Garcia, Spain was 46.4 years old, and increased to 56.5 years old from 2010 to 2014 [11]. And in Denmark, the average age of patients with spinal cord injury in 1990 was 29.0 years old, and increased to 47.5 years old in 2012 [12]. While in the United States, the average age of patients with spinal cord injury in 1993 was 40.5 years old, and increased to 50.5 years old in 2012 [13]. These reports also show that patients with spinal cord injury tend to be aging.

### 4.2. Spinal cord Injury and Gender Factors

In Dalian Port Hospital, the ratio of male to female was 2.83:1. Globally, male patients with spinal cord injury are more than women. In the United States, the male to female ratio of spinal cord injury patients is 2.41:1 [13], while in

Akita of Japan is 3.02:1 [14], and in St. Petersburg, Russia, The ratio is 2.4:1 [15]. In the domestic study of patients with spinal cord injury, the male to female ratio of patients with spinal cord injury in Tianjin is 2.9:1 [10]. And the ratio in Xi'an is 2.57:1 [16].

The reason for the majority of male patients with spinal cord injury is that in most countries, men undertake the main part of social labor, and they are more engaged in high-risk occupations, such as long-distance freight drivers, high-rise building workers, porters and mechanical operators, while women are mainly housewives or engaged in indoor work with less occupational risk, which makes men more exposed to dangerous environment than women. However, with the development of national and regional economy and modernization, the status of women will be improved accordingly, and the ratio of women to work will be increased. At the same time, some traditional and religious ideas that hinder women from going out to work will also change. Therefore, compared with developing countries, such as Turkey, the male to female ratio of spinal cord injury patients is 4.15:1 [17], and the ratio of men and women in developed countries is relatively low. Dalian is a large city in Northeast China, but its GDP in 2019 is lower than that of Tianjin and Xi'an. The reason why the male female ratio in this study is lower than that in Tianjin and Xi'an, and even lower than developed countries and regions abroad may be that our hospital is a rehabilitation hospital, and most of the patients hospitalized are in good economic condition, so the ratio of male and female is relatively low.

#### 4.3. Spinal Cord Injury Location

From the injury site statistics found that the incidence of cervical spinal cord injury in this study was the highest, accounting for 49.6% of the total number of patients. In other related studies, cervical spinal cord injury is the most common, accounting for 55% - 75% of all spinal cord injuries [8, 18]. Although the number of patients with cervical spinal cord injury in this study is not as large as that in the above studies, but it is still the largest in all injury planes in this study. We can also find that there are more patients with cervical spinal cord injury in 40-60 years old and above 61 years old. This may be related to the weakening of muscle strength around the spine and degenerative changes of the spine with the increase of age. It may also be related to the rapid development of our country, the improvement of medical and health conditions, and the extension of people's working years. In the research of Hao et al. [19] on spinal cord injury over 40 years old, it was found that SCI in cervical segment showed an upward trend, which was consistent with the results of this study. In addition, in this study, the male patients with SCI were more than the female patients in any injury plane, and the male patients with cervical spinal cord injury were significantly more than the female patients. This may be because men work more intensively, while women are mainly engaged in low intensity industries such as service industry. This is different from the result of Wang et al. [20] in the discussion on male and female spinal cord injury, the number of female patients over 60 years

old is more than that of male.

#### 4.4. Spinal Cord Injury and Treatment

In the treatment of spinal cord injury, it can be divided into surgical treatment and non-surgical treatment. In all the patients in this study, there are mainly two surgical methods: anterior or posterior decompression combined with internal fixation. Among them, 28 patients with cervical spine, 0 with thoracic vertebra and 2 with lumbar spine were operated by anterior approach. For the phenomenon of 0 in thoracic segment and 2 in lumbar spine, this study suggests that it may be related to the structure of thoracic vertebra and anterior lumbar spine, and the operation is complex and difficult. Because of the difficulty of operation, surgical treatment in the thoracolumbar region mainly use the way of the posterior approaches. Xu et al. [21] in the clinical experience of the treatment of thoracolumbar spinal cord injury, he used the posterior approach to treat thoracolumbar spinal cord injury, and found that it can help patients recover quickly.

In the comparative study of anterior and posterior approaches, Lu et al. [22] carried out comparative surgical treatment of anterior and posterior approaches for cervical segment, and found that both of them can obtain good surgical effect, but the related indexes of anterior approach are better than those of posterior approach. For cervical spine surgery, Yu et al. [23] also found that simple anterior surgery can obtain good decompression, fusion and other effects. However, when Zheng et al. [24] compared the anterior and posterior thoracolumbar surgery, the relevant data showed that the anterior approach could achieve good therapeutic effect, such as the patient's postoperative motor score, but in terms of blood loss and operation time, the anterior approach was worse than the posterior approach. Therefore, comprehensive consideration should be given to the surgical treatment, combined with the patient's own physical condition to choose the surgical method. For example, for the elderly in the surgical treatment, considering the poor tolerance of the elderly, excessive bleeding may lead to life-threatening, the posterior approach should be adopted.

### 5. Conclusion

According to the situation of patients admitted to Dalian Port Hospital, statistical analysis found that spinal cord injury showed different characteristics of age, gender, injury site and surgical methods. In this study, the age of patients with spinal cord injury is relatively high, and the sex ratio of male and female is relatively low, which is different from the characteristics of patients with spinal cord injury in other areas. However, the injury site of the patients was consistent with other research results. The anterior approach is often used in cervical spine surgery, while posterior approach is used in thoracolumbar surgery. Because this study is aimed at the epidemiological analysis of spinal cord injury patients who come to our hospital for rehabilitation treatment, the conclusion of this study may be different from that of general

hospitals. The specific reasons for this difference need to be further studied.

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