Management of spinal trauma in resource-limited circumstances during the COVID-19 pandemic: a literature review and case series including the first COVID-19 spinal trauma case in Egypt

Ali M. Maziad

Department of Orthopedic Surgery, Ain Shams University, Cairo, Egypt

Correspondence to Ali M. Maziad, MD, PhD, Department of Orthopedic Surgery, Ain Shams University, Cairo, Egypt. Tel: +2-010-67051543; e-mail: ali.maziad@gmail.com

Received: 3 October 2020
Revised: 15 November 2020
Accepted: 12 December 2020
Published: 16 October 2021

The Egyptian Orthopaedic Journal 2021, 56:61–69

Background data
In December of 2019, Covid-19 virus was discovered in the district of Wuhan, China. Within a few weeks, it affected almost every country in all six continents and was declared a pandemic by the World Health Organization (WHO). As of the date of writing this paper, there have been more than 85 million confirmed cases and more than 1.7 million deaths worldwide.
Given the very high contagiousness of the virus, strict precautions to avoid its spread among the population and particularly in health care facilities have been implemented around the world. Such measures proved to be helpful in providing some control over the spread. Still they were not fail proof in many situations whether in developed or developing countries, thus leading to further spread of the contagion and increased mortality.
Purpose
On February 14, 2020, the first Covid-19 case was reported in Egypt. In this article, we review the steps taken to limit the spread of Covid-19 at a busy tertiary hospital in Cairo, Egypt, and present a case series of patients with spinal trauma presenting during the peak phase of the pandemic in spring of 2020 and the rationale of their management including the first Covid-19 case in Egypt with acute spinal trauma and complete paraplegia operated upon in isolation.
Study design
This was a case series.
Patients and methods
The study was performed for short-term follow-up.
Results
Satisfactory results were obtained in this patient series with good clinical and radiological outcomes.
Conclusion
Precautionary measures are mandatory during the Covid-19 pandemic. TLICS classification is a simple algorithm that can help guide proper management.

Keywords:
Covid-19, spinal trauma, thoracolumbar injury, TLICS classification

Egypt Orthop J 56:61–69

1110-1148

Introduction

Covid-19 virus belongs to the same family of coronaviruses (COV) responsible for respiratory epidemics in the past, such as severe acute respiratory syndrome (SARS)-COV and the Middle East respiratory syndrome (MERS)-COV [1]. Transmission can occur through direct droplet infection or airborne and contaminated surfaces by virus particles [2].

Covid-19 can present with variable symptoms, which could range from mild symptoms in 80% of patients presenting with fever, cough, headache, and myalgia to more severe symptoms and dyspnea, up to respiratory failure requiring mechanical ventilation in 5% of cases. Mortality rate ranged from 2 to 3% in healthy individuals to up to 15% in elderly patients above 80 years, particularly those with comorbidities such as cardiovascular, diabetes, and pulmonary disease [3,4].

Although various protocols have been implemented in treatment of Covid-19, there is still no consensus among clinicians on the best definitive treatment for the disease. Vaccines are currently being developed, and early versions are starting to be approved with expected wide public use by early 2021 [5].

Given the rapid spread of the disease, Egypt, like other countries has implemented a travel ban in March of

2020 on travelers from highly infected countries to control the influx of Covid-19-infected patients into the country. There was also a 14-day quarantine protocol on all returning passengers from around the globe.

Along with an early implementation of a curfew, initially, certain hospitals in each region of the country have been assigned by the government as isolation hospitals for suspected patients. In addition, as the patient numbers grew, additional hospitals, vacant dormitories, public buildings, and even hotels were used for the same purpose.

The challenge was bigger at governmental and university tertiary hospitals that provided emergency causality services for the public at no charge and witnessed an overwhelming influx of patients with trauma, many of which were asymptomatic Covid-19-positive carriers, thus consuming a lot of resources, particularly PPE (Personal Protective Equipment) and that required for detection of the viral disease.

Our university hospital is one of the major tertiary medical centers in Cairo, Egypt, and has implemented a strict infection control and screening protocol to filter out any Covid-19-suspected patients presenting to its emergency department.

Besides the standard PPE for medical personnel, all patients requiring admission to the hospital were evaluated by internal medicine and respiratory physicians to exclude the potential for Covid-19 infection. Suspicion was based on vital signs, clinical examination, initial laboratory investigations, and CT of the chest, which were done for all patients. Suspected patients were isolated pending the results of nasal swab PCR.

In the initial phase of the pandemic, the university assigned a specific hospital outside the main medical campus for isolation and surgical procedures of Covid-19-infected patients. However, as the number of infected patients increased among the admitted emergency and trauma cases, a full section of the main surgery hospital was assigned for isolation and surgical procedures. Moreover, all elective procedures were put on hold during the peak of the pandemic. This coincided with a nationwide lockdown, travel ban, and curfew to limit viral spread.

To reduce medical staff exposure and avoid cross infection among them, the orthopedic surgery department assigned a separate team of surgeons and residents to manage the emergency services for each week of the month, alternating patient care, with each team going on self-quarantine at the conclusion of their week on duty. Thus, infection among the staff was kept to the minimum. In addition, any team operating on a Covid-19 case immediately went into self-quarantine for 14 days.

Thoracolumbar spine trauma and its management

Spine injuries are commonly associated with high-energy trauma such as motor vehicle accidents and falls from height. The thoracolumbar region is more commonly affected owing to the transition of forces from the fairly stable thoracic region to the more mobile lumbar region, which puts excessive biomechanical stresses on that region. Various classification systems such as Denis and AO classifications have been proposed; however, there has been uncertainty about their reliability and consistency for decision making [6–8].

The Thoracolumbar Injury Classification and Severity Score (TLICS) was introduced by Vaccaro *et al.* in 2005 [9]. It has been proven by many studies to provide high interobserver reliability and guidance to the decision making for the need of surgical intervention.

TLICS classification relies on analyzing three variables: (1) the morphology of the fracture pattern on radiological studies, (2) integrity of the posterior ligamentous complex (PLC), and (3) the neurologic status of the patient. After scoring each variable, treatment plan is determined according to the sum.

Scoring of the morphology of injury is classified into 3 predictors:

Fracture morphology

Compression type = 1, burst type = 2, translation/rotation type = 3, and distraction = 4.

Integrity of PLC

Intact = 0, suspected = 2, and injured = 3.

Neurological status

Intact = 0, nerve root = 2, complete cord = 2, incomplete cord=3, and cauda equina = 3. A total Score of 0–3 can be treated non-surgically, above 4 treated surgically, and 4 is undetermined or would depend on other patient-related factors [10–12].

In this article, we present a case series of 5 patients presenting during the peak of the pandemic with

various thoracolumbar injury patterns and the rationale of management for each case with available resources.

Case 1

On June 18th 2020, during the peak of the Covid-19 pandemic, a 25-year-old female patient presented to the emergency room with complete paraplegia and sensory level at T11 following a fall from a 5-floor building. Physical examination showed an ASIA A motor examination with 0/5 motor power in all muscle groups of both lower extremities with loss of sensation in all dermatomes, rectal tone, and perianal sensation.

CT scan imaging showed a burst fracture at L1 with partial dislocation at T12-L1. Axial cuts demonstrated complete obliteration of the spinal canal, which would suggest a severe direct injury to the spinal cord.

Besides minor lacerations in the liver and spleen which did not require surgical intervention by the general surgery team, the patient experienced a nondisplaced sacral fracture and fracture pubic rami, which also did not require surgical fixation. No other extremity injuries were identified.

As per the infection control protocol by the hospital, before admission, the patient was evaluated by internal medicine and respiratory physicians, who based on clinical examination, CT chest, and CBC (complete blood count) had a high suspicion for Covid-19 infection and that the patient needed to be isolated pending further confirmatory tests by PCR, which could take up to 48 h to obtain results. Given the need for isolation, we were also unable to obtain an MRI scan for fear of contaminating the only single MRI suite available serving the very busy emergency hospital.

Therefore, the MRI scan was deemed non-critical at that point given the patient's CT scans and complete paraplegia and that proceeding with surgical decompression and stabilization was the appropriate next step.

The initial challenge we faced was providing a regular isolation bed for the patient at the hospital, which was already full. Moreover, the patient would need post-surgical intensive care bed. To add more to our challenge, the surgical suite in the isolation section of the hospital was not readily equipped for spine procedures and needed to be further equipped immediately for the spine operation.

Another option was to transfer the patient to the more equipped isolation hospital outside the main campus. However, that would have significantly delayed surgical intervention, increasing the probability of complications for that patient.

A decision was thus taken to undergo surgical stabilization and decompression on the same day of admission to give the patient the best opportunity for any functional recovery.

The only available surgical suite in isolation section was quickly equipped to undergo the spine procedure. A C-Arm was transferred and spine instrumentation. The surgical table was not completely radiolucent which required some tedious adjustments during surgery to allow for taking some images during surgery. Only confirmatory images were taken after free hand screw placement to ensure proper placement of hardware. Surgery was done under strict infection control protocols in the isolation section of the hospital which required wearing full Covid-19 PPE (double gowning using full body waterproof suit along with sterile, disposable waterproof gowns. Moreover, N-95 masks along with regular surgical mask and face shield and finally triple gloving). This made the surgery more tiresome for the surgical staff.

General anesthesia was administered by the anesthetist with the surgical team outside the operative room in order to reduce their risk of exposure to infection. This was followed by patient positioning and a standard posterior approach. During the approach, use of electrocautery was kept to the minimum using low settings to reduce viral aerosol generation with most of the exposure done with blunt subperiosteal dissection using cobb elevator. Injury of the posterior spinal elements was noted with gross spinal instability and translation.

Bilateral pedicle screws were placed at T10- L3, skipping the completely comminuted fractured level, L1. It is worth mentioning that such complex procedure on a Covid-19-infected patient is not the proper time for training residents. Moreover, important to note is that simple yet, safe and efficient 'Free Hand Technique' for screw placement becomes invaluable in this situation to limit reliance on intraoperative imaging and x-ray exposure. Excessive use of C-arm, navigation, and robotics will increase the surgical time, thus exposing the fragile patient to a higher risk for complications and also the surgical team. Thus, imaging is preferably used only for screw position confirmation after placement rather than step-by-step guidance.

Following confirmation of proper hardware placement, reduction of the spinal malalignment was done

followed by complete decompression at the T12/L1 level. Severe spinal cord laceration was noted and documented. Metal rods were placed and a good final alignment was confirmed by C-arm. Decortication of the bone surfaces was done, and local bone graft was utilized for fusion.

The patient was transferred in a stable state to the intensive care unit where she remained for 1 day and then transferred to a regular isolation bed. Patient remained in isolation until a negative PCR was obtained, and the patient was deemed stable to be transferred out of isolation and then home.

At 3 months of follow-up, unfortunately, given the severity of the injury, the patient did not recover any motor function in the lower extremities. She did regain some sensation in the upper thigh bilaterally; however, there was no bowel or bladder control. She is wheelchair bound, complains of no back pain, and working with rehabilitation for lifestyle adjustments Fig. 1.

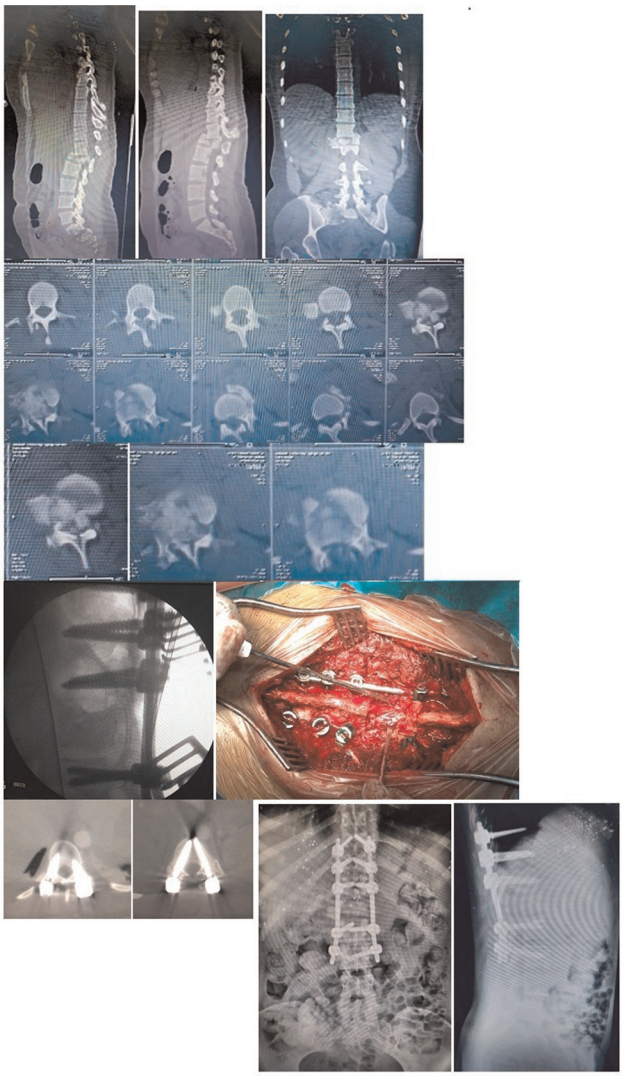
Case 2

A 20-year-old male patient involved in a MVA (Motor Vehicle Accident) presented with an L1 compression fracture (1) with involvement of the posterior vertebral wall (+1 burst component) and intact PLC with no neurological involvement. He was treated conservatively with a brace for 2 months, and at 3 months of follow-up, he showed resolution of back pain symptoms with good spinal alignment (Fig. 2).

Case 3

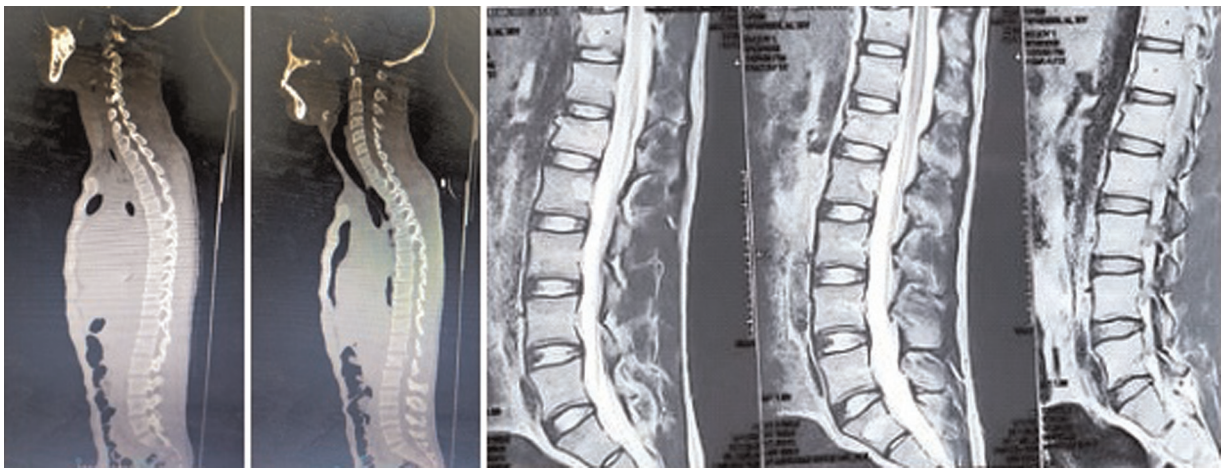
A 30-year-old female presented with an L1 burst fracture (2), loss of more than 40% of vertebral height, and 50% canal compromise. Intact PLC and no neurological

Figure 1



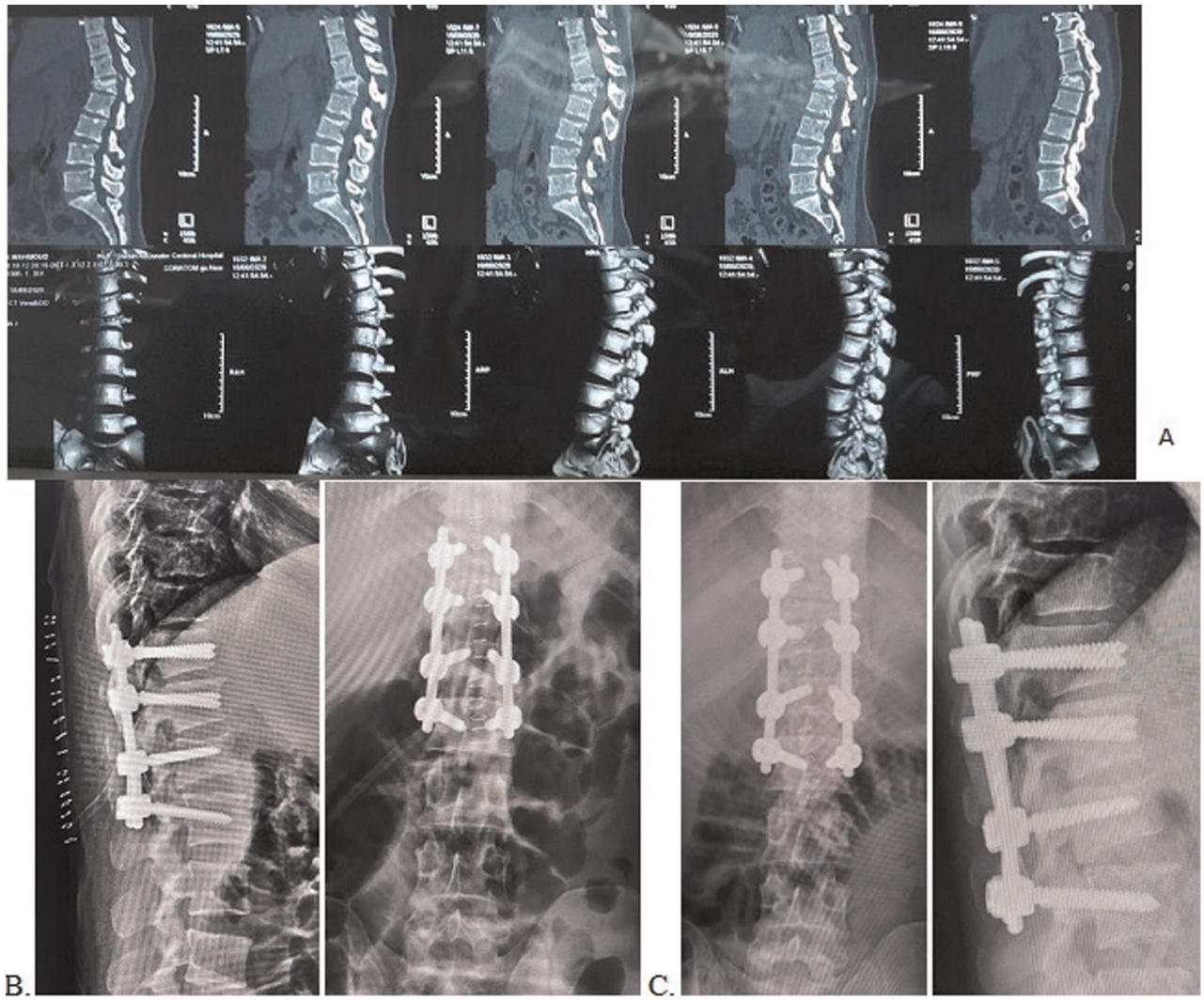
(a) Showing T12/L1 fracture dislocation with complete obliteration of the spinal canal by comminuted boney fragments in axial view. (b) Intraoperative images showing height restoration of fractured vertebra and laceration of spinal cord. (c) 3-month postoperative AP/Lat x-rays showing maintained good spinal alignment.

Figure 2



Stable burst fracture treated in a brace.

Figure 3



(a) L1 Unstable burst fracture. (b) Postoperative X-rays with good restoration of L1 vertebral height and spinal alignment. (c) Follow-up x-rays at 3 months.

symptoms were seen. Moreover, a fracture of the lamina of L1 was noted. Thus, a 3-column involvement requiring stabilization of PSF, T11-L2, was noted. Given the patient's young age, we aimed to preserve as many mobile segments as possible with a preoperative goal of stopping fixation at L2. During surgery, L1 vertebral body height was adequately restored by ligamentotaxis, and two short screws were placed at L1 fractured level, which provided sufficient fixation points to end the construct at L2 level. Additionally, given the intact neurological status, decompression was considered unnecessary in that patient. If any preoperative neurological symptoms were noted, decompression would have been necessary (Fig. 3).

Case 4

A 35-year-old male with mental illness presented with an L3 burst fracture following an attempted suicide. Imaging showed an intact PLC and posterior column boney elements. He had no neurological symptoms. However, he also experienced a comminuted sub-trochanteric femoral fracture. TLICS score was 2. Ideally, the patient would be treated using temporary percutaneous screws till fracture union. However, that option was not available owing to limitation of resources. Thus, given the relative stability of the lumbar fracture, and comminution of the femoral fracture requiring minimal activity after internal fixation, we opted to treat the spine fracture conservatively in a brace in order to preserve spinal mobility for the patient, particularly that the fracture is at L3 which would require lower lumbar fixation leading to marked limitation of spinal mobility if spinal fusion was chosen.

Although per the TLICS score, stable burst fractures in neurologically intact patients are considered non-operative, there may be a need for a delayed surgical intervention if excessive local kyphosis and/or

persistent pain develops [13]. Following a short period of bed rest, at 3 months of follow-up, this patient maintained adequate vertebral height and alignment using a back brace with graduated weight bearing for femoral fracture Fig. 4.

Case 5

A 32-year-old manual laborer fell from a scaffold at the 4th story while working. He sustained a 'flexion distraction; injury at T12-L1 involving boney and ligamentous structures. He also had bilateral

Figure 4

L3 burst fracture and neurointact with intact PLC. TLICS score of 2, spine treated conservatively in a brace and subtrochanteric fracture femur treated by proximal femoral nail.

calcaneal fractures. Fortunately, the patient was neurointact on presentation. It is very important to meticulously scrutinize each and every cut of the imaging studies in such injuries as the distraction component (signifying instability requiring fixation) can be easily missed and the injury mistaken as a compression fracture if not carefully reviewed by the surgeon.

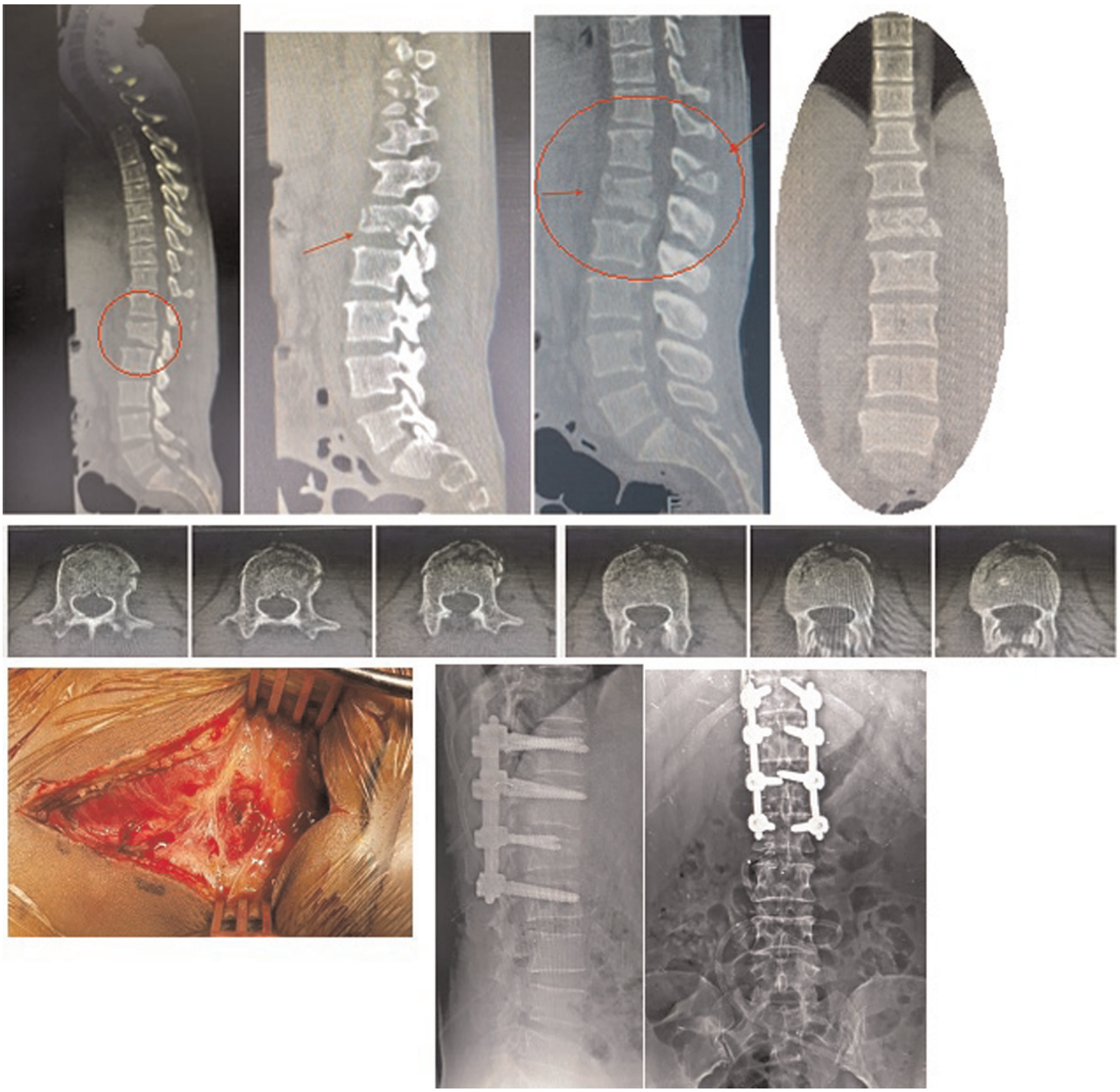
Per the TLICS score, the patient has a score of **7** (distraction injury = 4, PLC injury = 3, and neurointact = 0), which required surgical stabilization (Fig. 5).

Discussion

As an unknown pathogen, Covd-19 virus caused a pandemic that hit the world hard by surprise in early 2020. With the rapid rate of spread and limited resources to face the disease, hospitals around the world continue to face big challenges dealing with causalities at this difficult time.

Although precautions are necessary at all times to limit the spread of the disease, sound medical judgment and proper use of available resources must be stretched to new limits to protect health care workers and provide

Figure 5



(a) CT cuts showing injury that can be easily mistaken as a compression fracture if the distraction component of the injury pattern is missed (red arrows). (b) Intraoperative picture showing a complete tear of the posterior ligamentous complex (PLC) just after exposure of the lumbar fascia. (c) Postoperative AP/Lat x-rays showing good spinal alignment.

optimum patient care within the limitation of resources during the pandemic.

The North American Spine Society as well as other international organizations have published guidelines for management of spinal cases during the pandemic [14–17], with the goal of limiting disease spread among the general public as well as health care personnel. All guidelines agreed that elective procedures were to be kept on hold during the peak of the pandemic. Moreover, all agreed that emergency situations involving spinal trauma or neurological deficits should proceed under strict precautions particularly where Covid-19 infection is suspected or confirmed.

It cannot be stressed enough that having an experienced internal medicine and respiratory team is crucial for effective screening of patients in the emergency room. Reliance on PCR alone is not only very time consuming, requiring up to 24–48 h to obtain results, but also there are reports that PCR studies may carry up to 21% false-negative results. Thus, utilizing other modalities such as CT chest along with laboratory studies may provide a more effective screening tool in the emergency setting, as they may detect changes with up to 98% sensitivity even in asymptomatic patients and can help triaging to either regular beds or isolation wards until further confirmatory results are obtained [17,18].

In this case series, we presented different spinal trauma cases requiring different rationale in treatment plans demonstrating the reliability of the TLICS classification in decision making for thoracolumbar trauma. To our knowledge, we also present the first spinal trauma case in Egypt operated upon in isolation for Covid-19 and the challenges we faced for a quick intervention that limited complications in such a fragile patient.

With the main goal of preservation of life, a number of logistical challenges had to be tackled to avoid transfer of this patient to another Covid-19 isolation hospital, which was considered very risky to the patient, causing further delay of stabilization. Studies have reported that Covid-19 cases undergoing surgery have a higher risk of major complications (up to 20%) as compared with non-Covid patients with a higher percentage (up to 8%) requiring postoperative ICU care which may be attributed to surgical stress further exacerbating their symptoms [19]. Thus, the expectation of postoperative deterioration required securing an ICU bed in an already overbooked Covid isolation section. We also needed immediate preparation of the available small surgical suite to carry out the spine procedure safely.As described in other publications, certain precautions need to be taken in such critical cases. The surgical team should preferably remain outside the room during induction of anesthesia to reduce exposure, should wear waterproof gowns under sterile surgical scrubs, and should use N-95 mask and face shields, which add an extra physical burden on the surgeon.

Minimizing the use of electrocautery may limit aerosol generation and transmission to the surgical team, which has previously been described as a possible mode of transmission for viral particles [20]. Moreover, keeping equipment in the room to the minimum and efficient utilization of surgical time can help reduce overall complications for both patients and medical personnel.

It is also advisable to use a single approach surgery to reduce morbidity to the patient, and also the prone position is preferable as it reduces exposure of surgical team to Covid-19 infection.

Conclusion

Covid-19 pandemic had a tremendous negative effect on health care worldwide. As the second hit approaches, we should be more prepared to face the new challenges of increasing patient numbers and harness the experiences gathered previously. Full collaboration and open communication channels between orthopedic surgeons and other involved specialties in emergency situations are crucial for accelerated and efficient patient management during the pandemic to limit hospital stays, reduce hospital-acquired infections, and obtain more favorable surgical outcomes.

When it comes to spinal trauma during the pandemic, limited resources should be directed toward surgical intervention when absolutely indicated. Simple and borderline cases are better considered for conservative management.

TLICS classification is a simple algorithm that can help guide proper management. Still, each case should be approached individually during this pandemic to limit hospital stays and reduce spread of the disease.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Zhu N, Zhang D, Wang W, Li X, Yang B, Song J. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020; 382:727–733.

2 Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: an overview. J Chin Med Assoc 2020; 83:217–220.

3 Lauer SA, Grantz KH, Bi Q, *et al.* The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med 2020; 172:577–582

4 Huang C, Wang Y, Li X, *et al.* Clinical features of patients infected with2019 novel coronavirus in Wuhan, China. Lancet 2020; 395:497–506.

5 Del Rio C, Malani PN. COVID-19—new insights on a rapidly changing epidemic. JAMA 2020; 323:1339–1340.

6 Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. Spine 1983; 8:817e831.

7 Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. Eur Spine J 1994; 3:184e201.

8 Shimer AL, Su BW. Operative versus nonoperative treatment of thoracolumbar burst fractures. Semin Spine Surg 2010; 22:38e43.

9 Vaccaro AR, Lehman RA Jr, Hurlbert RJ, *et al.* A new classification of thoracolumbar injuries: the importance of injury morphology, the integrity of the posterior ligamentous complex, and neurologic status. Spine 2005; 30:2325–2333.

10 Lee JY, Vaccaro AR, Lim MR, *et al.* Thoracolumbar injury classification and severity score: a new paradigm for the treatment of thoracolumbar spine trauma. J Orthop Sci 2005; 10:671–675.

11 Lewkonia P, Paolucci EO, Thomas K. Reliability of the thoracolumbar injury classification and severity score and comparison with the Denis classification for injury to the thoracic and lumbar spine. Spine 2012; 37:2161–2167.

12 Vaccaro AR, Rihn JA, Saravanja D, *et al.* Injury of the posterior ligamentous complex of the thoracolumbar spine: a prospective evaluation of the diagnostic accuracy of magnetic resonance imaging. Spine 2009; 34: E841–E847.

13 Vaccaro AR, Zeiller SC, Hulbert RJ, *et al.* The thoracolumbar injury severity score: a proposed treatment algorithm. J Spinal Disord Tech 2005; 18:209–215.

14 The National Health Service. Specialty guides for patient management during the Coronavirus pandemic. Clinical guide for the management of patients requiring spinal surgery during the Coronavirus pandemic. Available from: https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/ 2020 /03/specialty-guide-management-of-patients-requiring-spinal-surgery-v 1-20-march-2020. pdf. Accessed 3 May 2020

15 Zou J, Yu H, Song D, *et al.* Advice on standardized diagnosis and treatment for spinal diseases during the Coronavirus disease2019 pandemic. Asian Spine J 2020; 14:258–263.

16 North American Spine Society. NASS guidance document on elective, emergent and urgent spine procedures and treatments. Available from: https://www.spine.org/Portals/0/assets/downloads/Publications/NASSInsider/NASSGuidanceDocument 0403 20. pdf. Accessed 3 May 2020

17 Li Y, Yao L, Li J, *et al.* Stability issues of RT-PCR testing of SARS-CoV-2 for hospitalized patients clinically diagnosed with COVID-19. J Med Virol 2020; 92:903–908.

18 Fang Y, Zhang H, Xie J, *et al.* Sensitivity of chest CT for COVID-19: comparison to RT-PCR. Radiology 2020; 296:E115–E117.

19 Lei S, Jiang F, Su W, *et al.* Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. EClinicalMedicine 2020; 21:100331.

20 Johnson GK, Robinson WS. Human immunodeficiency virus-1 (HIV-1) in the vapors of surgical power instruments. J Med Virol 1991; 33:47–50.