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Multilevel Noncontiguous Spinal Fractures Involving Seventeen Vertebrae: A Rare Case Report

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ABSTRACT

Multilevel noncontiguous spinal fractures are defined as injuries to the vertebral column at more than one site and separated by at least a single uninjured vertebra. We report the case of a 39-year-old man being hit by a moving train, breaking much of his spine, surviving, and returning to gainful employment. He sustained multilevel noncontiguous spinal fractures involving 17 vertebrae (C1, 2, 4, 6, 7, T1, 2, 6, 7, 8, 9, 10, 11, 12, L1, 2, 5). He was treated using a modified external fixator for cervical spine fractures and posterior spinal instrumented fusion for L1 burst fracture, while the remaining stable fractures were managed conservatively. The purpose of this report was toemphasize the need for careful radiological evaluation in patients with high-energy trauma, and the option of treating such complex injuries by non-operative means.

INTRODUCTION

Multilevel Noncontiguous Spinal Fractures (MNSF) are a rare and special type of spinal injuries [1].They are defined as injuries to the vertebral column at more than one site and separated by at least one uninjured vertebra [2-4]. They occur as result of high-velocity trauma, in which the dissipation of high forces leads to multilevel involvement [5]. Their incidence ranges from 1.6% to 23.8% in various literatures done in various countries and various setups [6]. Patients sustaining such injuries have wide variety of problems ranging from mild local pain to quadriplegia or even death may occur [7]. We report a 39-year-old man who sustained multilevel noncontiguous spinal fractures involving 17 vertebrae following a railway accident. To the best of our knowledge, this case is the most multiple vertebral fractures so far reported in the literature.

CASE REPORT

A 39-year-old man was transferred to our hospital from local clinic after railway accident (A pedestrian struck by train). Physical examination revealed an extensive tenderness from the posterior neck to lower back. Neurological examination showed hypoaesthesia over the right L1dermatomal distribution. Initial spine X-rays showed noncontiguous fractures of C2, C4 and L1 (Figure 1A, B).

Sagittal Computed Tomography (CT) scanning of the cervicalspine confirmed a posteriorly displaced C-2 type II odontoid fracture and fracture of spinous process of

C4 (Figure 2). Sagittal CT scans of thoracolumbar spine showed compression wedge fractures of T9, T10 and L5; burst fracture of L1; fractures of spinous processes of T6, T10, T11 and T12 (Figure 3A, B).Axial CT scans of cervical spine showed C1 burst fracture (Jefferson fracture); fractures of C4 vertebral body, left articular facet and both lamina; C6 left articular facet and C7 left transverse process (Figure 4A, B, C, D). Axial CT scans of thoracic spine showed fractures of T1 vertebral body, left pedicle, lamina and transverse process;fractures of T2vertebral body, left lamina and transverse process and fracture of T7 left transverse process (Figure 5A, B, C). They further showed compression wedge fractures of T9 and T10 (Figure 6A, B). Axial CT scans of lumbar spine revealed burst fracture of L1, fractures of both pedicles of L2 and compression wedge fracture of L5 (Figure 7A, B, C). Moreover, sagittal T2-weighed magnetic resonance imaging revealed expansion of fractures into the spinal canal at the level of L1 vertebra (Figure 8).

Due to the marked instability of C2 fracture, conservative treatment by modified external fixator has been performed under the C-arm after reduction by skull traction on a halo ring was obtained 24 hours post admission. It was made by the halo ring, the Ilizarov system and the halo vest (artificial synthetic jacket) was replaced by the plaster of Paris (Figure 9). Two days later, he underwent reduction, laminectomy of L1, as well as posterior instrumentation and fusion of T11 toL3 (Figure 10). Short constructs involving fixation anchors 2 above and 2 below the laminectomy site enabled good sagittal alignment and preservation of the L5/S1 mobile segment. Recovery was uneventful. The modified external fixation was removed 3 months postoperatively. At 1 year postoperatively, spinal correction was well-maintained (Figure 11). At year 2, the patient reported pain-free spinal mobility and had returned to work. The outcomes from the treatment provided are satisfactory. The amount of minor spine injuries here would be the risk of progressive kyphotic deformity. Fortunately, it does not appear that occurred over the two year post operative period which is reassuring (Figure 12A). Moreover, control flexion/extension views of the cervical spine showed that the halo treatment was successful (Figure 12B, C).

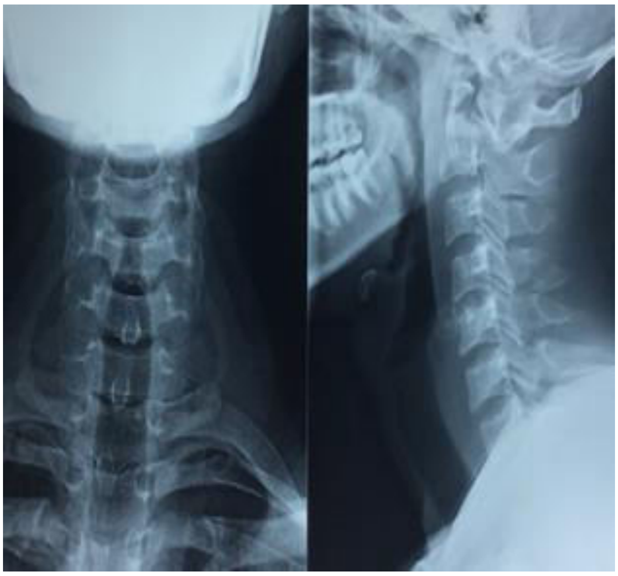
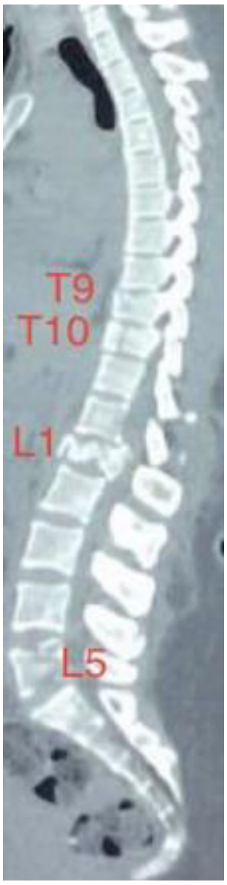


Figure (1A): Anteroposterior and lateral radiographs of the cervical spine showing the fractures of odontoid and spinous process of C4.

Figure (1B): Anteroposterior and lateral radiographs of the thoracolumbar spine revealing the burst fracture of L1.

Figure 2: Sagittal Computed Tomography scanning of the cervical spine showing a posteriorly displaced C-2 type II odontoid fracture and fracture of spinous process of C4.



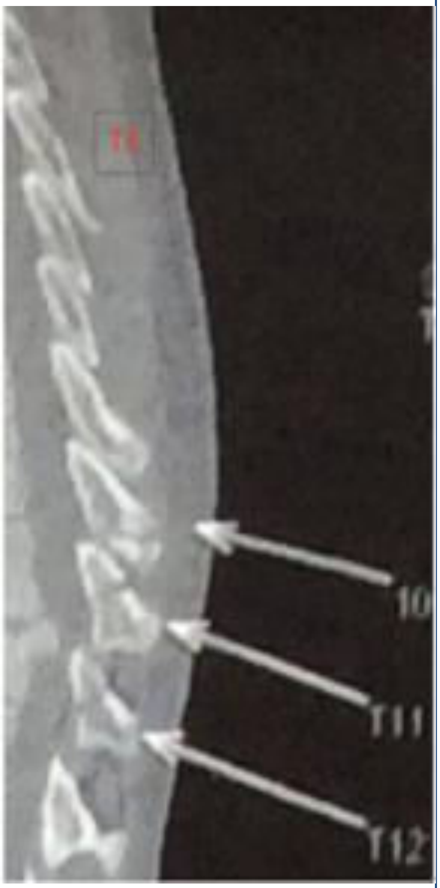


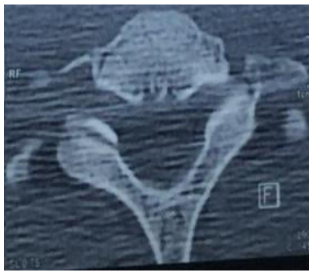
Figure (3A): Sagittal CT scanning of thoracolumbar spine showing compression wedge fractures of T9, T10 and L1 and burst fracture of L1.

Figure (3B): Sagittal CT scanning of thoracolumbar spine showing fractures of spinous processes of T6, T10, T11 and T12.

(4A)

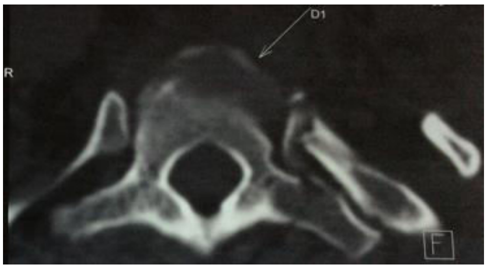
(4B)

(4C)



(4D)

Figure (4A): Axial CT scan of C1 showing C1 burst fracture (Jefferson fracture).
Figure (4B): Axial CT scan of C4 showing fractures of vertebral body, left articular facet and both laminae.
Figure (4C): Axial CT scan of C6 showing fracture of left articular facet.
Figure (4D): Axial Ct scan of C7 showing fracture of left transverse process.



(5A) (5B) (5C)

Figure (5A): Axial CT scan of T1 showing fractures of vertebral body, left pedicle, lamina and transverse process.
Figure (5B): Axial CT scan of T2 showing fractures of vertebral body, left lamina and transverse process.
Figure (5C): Axial CT scan of T7 showing fracture of left transverse process.

Figure (6A): Axial CT scan of T9 showing compression wedge fracture.

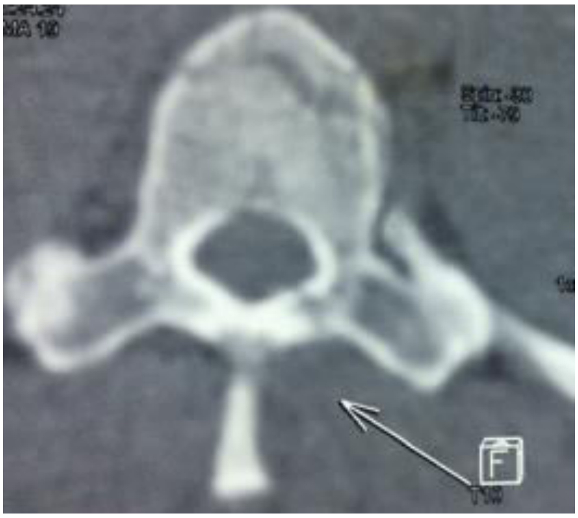


Figure (6B): Axial CT scan of T10 showing compression wedge fracture

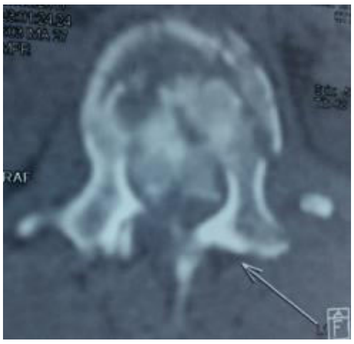


Figure (7A): Axial CT scan of L1 showing burst fracture.

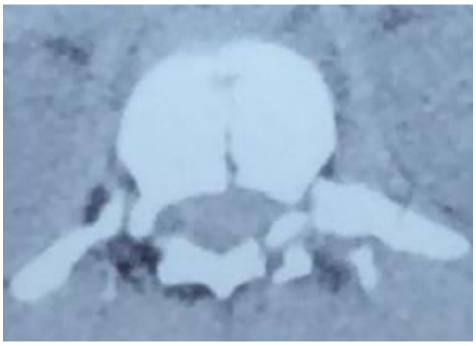


Figure (7B): Axial CT scan of L2 showing fractures of both pedicles.

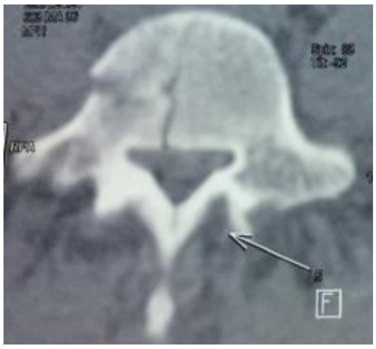
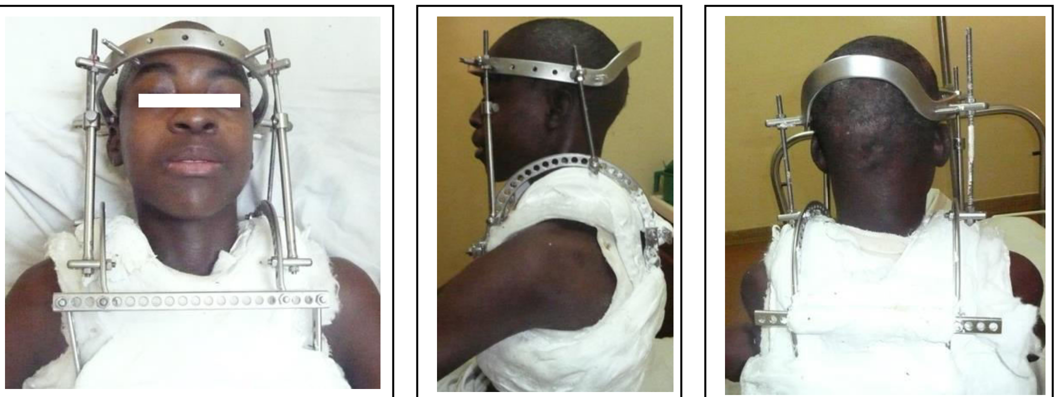


Figure (7C): Axial CT scan of L5 showing compression wedge fracture.

Figure 8: Sagittal T2-weighed magnetic resonance imaging revealing expansion of fractures into the spinal canal at the level of L1 vertebra



(9A) (9B) (9C)

Figure 9: Modified external fixator made of halo ring, Ilizarov system and plaster of Paris on anterior view (9A), lateral view (9B) and posterior view (9C).

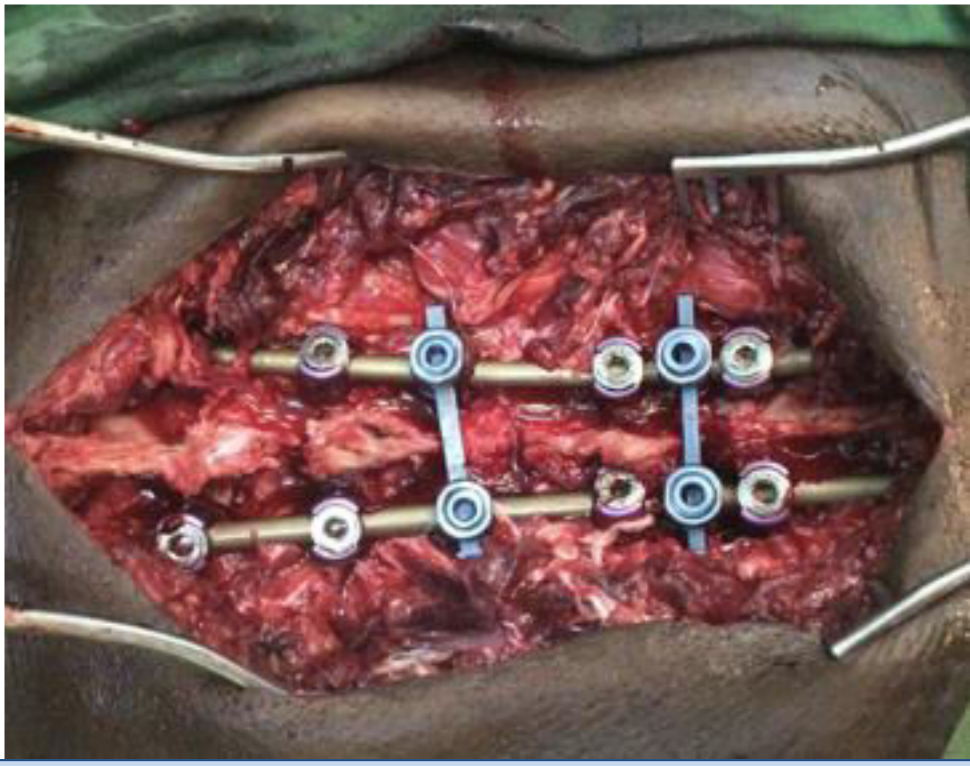


Figure 10: Intraoperative view showing fusion with Spine System T11/T12 – L2/L3

Figure (11A): A 1-year follow-up sagittal CT scan of the cervical spine showing bone healing.

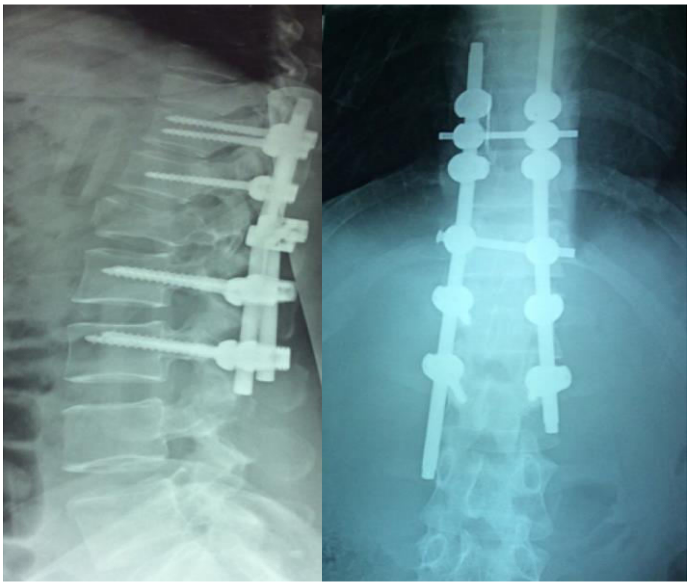
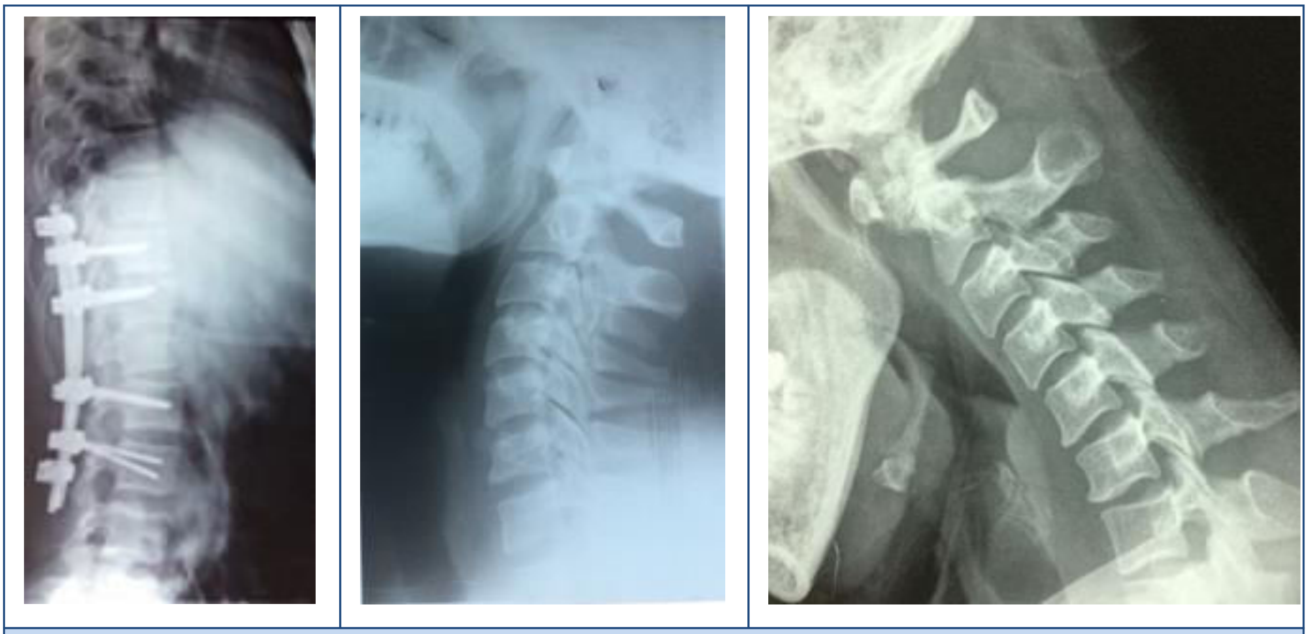


Figure (11B): Anteroposterior and lateral views of thoracolumbar spine showing well-maintained correction of the spine at postoperative year 1.



(12A) (12C) (12C)

Figure (12A): Control lateral radiograph of the thoraco-lumbar spine in hyperextension showing bone healing without signs of kyphotic deformity at postoperative year 2.

Figure (12B,C): Hyperextension (12B) and hyperflexion (12C) views of the cervical spine showing that the halo treatment was successful at postoperative year 2.

DISCUSSION

The incidence of multilevel noncontiguous spinal fractures is not as low as commonly believed [8]. However, the relevant bibliography is scanty. Kewalramani and Taylor reported an incidence of 4.2% for multiple noncontiguous injuries of the spine [9]. Other authors reported an incidence of multilevel noncontiguous spinal fractures varying between 4 to 24% of patients involved in traffic accidents or falls from a height [2,10-12]. Their incidence may even rise higher up to 77% depending on the type of imaging modality used [13]. An increase of motor vehicle accidents and amelioration of diagnostic techniques, are attributed to the gradual increase of the reported incidence of these lesions [2,14]. The definition of these injuries is not clear in the literature. Its previous definition was that at least three intact vertebrae should be included between two injured or fractured vertebrae [2]. However, Iencean [3] suggested that in multilevel noncontiguous spinal fractures there was at least a normal spinal segment between the lesions of the same structural type as the injured segments. In our case, we followed Iencean's definition as multilevel noncontiguous spinal fractures.

Multilevel noncontiguous spinal fractures occur as result of high-velocity trauma, in which the dissipation of high forces leads to multilevel involvement [5,15].The high number of involved vertebra in multilevel injuries reported in modern English literature is 12 and these were at contiguous level [16]. After a thorough physical examination of the patient, radiological evaluation of the entire spine is essential in patients with multilevel spinal injuries. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) aid in the diagnosis and assist in surgical planning [13,17,18]. Delayed or missed diagnosis of multilevel spinal injuries can lead to instability, neurological compromise, and deformity [19,20]. Based on the imaging findings, five common patterns of multilevel noncontiguous spinal fractures have been previously reported: pattern I: cervical and thoracic, pattern II: thoracolumbar and lumbosacral, pattern III: thoracic and thoracolumbar, pattern IV: cervical and thoracolumbar and pattern V: lumbosacral and associated injuries [13]. In our case, the cause of injuries was railway accident which is a high-energy trauma and this explains the complexity of the injury mechanism and the subsequent involvement of 17 vertebrae. Conventional radiographs have only identified fractures of 3 vertebrae (C2, C4 and L1). Advanced imaging techniques (CT and MRI) helped to diagnose the remaining injuries. The pattern of injury in our case is cervico-thoraco-lumbar.

Treatment for the multilevel noncontiguous spinal fractures must follow the same guidelines for treatment as for the isolated fracture in the majority of circumstances [15]. However, special consideration must be given to all lesions in their treatment to avoid conflicting influences of the multiple lesions. Instability of the spine, deformity and neurological deficit are major factors when selecting treatment [2,6]. Treatment should aim to achieve mechanical and neurological stability as well as alignment and deformity correction. The viability of non-operative options should be considered when there is extensive injury [7].The C-2 type II odontoid fracture is unstable fracture and internal fixation would often be recommended in such situation. However, nonoperative management with rigid external immobilization with a halo has been described in numerous series [21,22]. In our case, as we did not dispose appropriate implants for internal fixation, we have opted for conservative treatment by modified external fixator. Flexion/extension views of the cervical spine showed that the halo treatment was indeed successful. Only the unstable fractures of L1 were treated surgically. Posterior stabilization with a long construct may lead to adjacent level disc disease. Therefore, we decided to use a short construct and achieved good outcome.

CONCLUSION

In case of spine fractures resulting from high-energy trauma, Computed Tomography and Magnetic Resonance Imaging of the whole spine are efficient in detecting multilevel noncontiguous spinal fractures. Life support principles guide initial management, and stable levels of injury are treated conservatively while all unstable levels must be fixed surgically. The clinical course in this case report was interesting in that the patient sustained a-17-vertebral injury that eventually fully healed.

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Informed consent: The informed consent was obtained from the child's parents to publish the information, including his photograph.

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