Physiotherapy Research International

WILEY

RESEARCH ARTICLE

Analysis of Medical Rehabilitation Needs of 2023 Kahramanmaraş Earthquake Victims: Adıyaman Example

Esin Akbaş[1] | Kezban Bayramlar[2]

[1]Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Adıyaman University, Adıyaman, Turkey | [2]Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Hasan Kalyoncu University, Gaziantep, Turkey

Correspondence: Esin Akbaş (eakbas@adiyaman.edu.tr)

Received: 26 July 2024 | **Revised:** 4 October 2024 | **Accepted:** 19 October 2024

Funding: The authors received no specific funding for this work.

Keywords: amputation | compartment syndromes | natural disasters | physical therapy modalities | traumatic

ABSTRACT

Background: Natural disasters, particularly earthquakes, result in numerous injuries, including spinal cord injuries, traumatic brain injuries, limb amputations, fractures, and peripheral nerve injuries. This study aimed to investigate the types of orthopedic injuries sustained by earthquake survivors who require long-term rehabilitation, as well as to assess the rehabilitation programs, orthoses, prostheses, and assistive devices employed.

Methods: This descriptive analysis was conducted at a physical medicine and rehabilitation clinic. Data on earthquake survivors were recorded retrospectively. The study included survivors who presented to the clinic between April 15, 2023, and May 1, 2024, with injuries sustained during the Kahramanmaraş earthquakes that occurred on February 6, 2023. The types of orthopedic injuries, rehabilitation programs, and orthoses-prostheses used were documented.

Results: Data from 223 earthquake survivors were analyzed. Among these, 97 (43.5%) had compartment syndrome, 65 (29.1%) had amputations, 57 (25.6%) had fractures, 20 (9%) had peripheral nerve injuries, 12 (5.4%) had soft tissue injuries, and two (0.9%) had dislocations. Physiotherapy was provided to 211 (94.6%) patients, occupational therapy to 56 (25.1%), amputation rehabilitation to 65 (29.1%), and electrotherapy to 12 (5.3%). Prostheses were fitted for 37 (16.5%) amputees, orthoses were used by 57 (25.6%) patients, and 103 (46.1%) required assistive devices.

Conclusion: Among earthquake-related injuries requiring medical rehabilitation, compartment syndrome was the most common. The rehabilitation process of patients who developed compartment syndrome and amputation continues 1 year after the earthquake. Adults were the most frequently affected age group. The data obtained in this study will help plan local health services to coordinate medical rehabilitation in earthquakes.

1 | Introduction

On February 6, 2023, at 04:17, a 7.7 magnitude earthquake struck the Pazarcık district of Kahramanmaraş, Türkiye. Later that same day, at 13:24, a second earthquake with a magnitude of 7.6 occurred 148 km north in the Elbistan district. These two earthquakes affected 11 provinces, with Kahramanmaraş, Hatay, and Adıyaman being among the most impacted. According to data from the Disaster and Emergency Management Presidency, 115,353 people were injured, and 50,783 people died (Afet ve Acil Durum Yönetimi Başkanlığı (AFAD) 2023).

Natural disasters, particularly earthquakes, result in a wide range of injuries, including spinal cord injuries (SCI), traumatic brain injuries, limb amputations, fractures, and peripheral nerve injuries (Gosney et al. 2011). While disaster management plans

typically focus on the establishment of medical aid centers, transportation and admission of injured individuals to hospitals, the deployment of healthcare personnel, such as doctors and nurses, to affected areas, and the implementation of triage and early surgical intervention (Schultz, Koenig, and Noji 1996; Sever, Vanholder, and Lameire 2006) the field of physical and rehabilitation medicine has not received adequate attention in disaster planning and response. Neglecting rehabilitation programs during the emergency response can prolong hospital stays, increase complications, and lead to functional losses specific to the injury, resulting in long-term adverse outcomes for both individuals and society (Gosney et al. 2011). Rehabilitation programs targeting post-emergency injuries can significantly reduce disability in earthquake survivors (World Health Organization 2013). To effectively plan rehabilitation services, it is essential to better understand the specific types and clinical characteristics of earthquake-related injuries (H. Li et al. 2018). The literature includes studies on the rehabilitation needs of fractures, spinal cord injuries, and amputations resulting from earthquakes (Rathore et al. 2008; Zhang et al. 2012; Knowlton et al. 2011). The current study aimed to identify the clinical characteristics of orthopedic injuries, particularly compartment syndrome, among earthquake survivors requiring long-term rehabilitation, as well as to determine the rehabilitation programs, orthoses, prostheses, and assistive devices employed.

2 | Method

This *descriptive analysis* was conducted at a physical medicine and rehabilitation clinic. Data from earthquake survivors who received medical rehabilitation at our hospital were recorded retrospectively. The study was approved by the Non-Interventional Research Ethics Committee of Hasan Kalyoncu University Health Sciences Faculty (2024/84), and conducted in accordance with the Declaration of Helsinki. The study included survivors who presented to the clinic between April 15, 2023, and May 1, 2024, with injuries sustained during the Kahramanmaraş earthquakes that occurred on February 6, 2023. Patient records from the hospital information system were used for data collection. The demographic information of the survivors was recorded, along with injury types, affected extremities, number and location of amputated limbs, rehabilitation programs applied, orthoses and prostheses used, and assistive devices required.

The rehabilitation programs applied included physiotherapy, occupational therapy, amputation rehabilitation, and electrotherapy. The physiotherapy program comprised joint range of motion exercises, stretching, strengthening exercises, electrical stimulation, and mobilization. Amputation rehabilitation focused on edema control, elastic bandaging to shape the residual limb, joint range of motion exercises to prevent contractures, and strengthening exercises. Occupational therapy for upper extremities included training in activities of daily living. Electrotherapy involved the use of hot packs, transcutaneous electrical nerve stimulation, and ultrasound.

For statistical analysis, IBM SPSS v. 22.0 software (IBM Corp., Armonk, NY, USA) was used. Descriptive statistics were presented as percentages and frequencies for categorical variables, and as mean, standard deviation, and minimum–maximum values for continuous variables. Differences between categorical variables were analyzed using the chi-square test. The significance level was set at $p < 0.05$.

3 | Results

A total of 223 earthquake survivors presented to the clinic for rehabilitation. Due to the impact of the earthquake on our hospital and issues related to housing, survivors were referred to hospitals in neighboring provinces and districts for rehabilitation during the first 2 months. Table 1 shows the demographic data of the survivors. The mean age of the survivors was 35.5 ± 15.5 (range: 2–86) years. *The survivors were categorized into pediatric (1–18 years), adult (19–64 years), and geriatric (≥ 65 years) age groups*. There was a statistically significant difference between these age groups ($X^2(2)$: 165.318, $p = 0.000$), with the adult group being the most affected.

Table 2 presents the affected extremities and orthopedic injury types of the 223 survivors. *In the pediatric age group, one (2%) patient had a soft tissue injury, four (8%) had nerve injuries, seven (14%) had fractures, 13 (26%) had amputations, and 31 (62%) had compartment syndrome*. Among the injury types, soft tissue injuries and dislocations were the least common. Soft tissue injuries were mostly due to crush injuries and were localized in

TABLE 1 | Demographic characteristics of earthquake victims.

	Number of patients (%)
Age groups	
1–18 years	50 (22.4)
19–64 years	162 (72.6)
≥ 65 years	11 (4.9)
Gender	
Female	117 (52.5)
Male	106 (47.5)

TABLE 2 | Clinical characteristics of earthquake victims.

	Number of patients (%)
Injured body parts	
Upper limb	80 (35.8)
Lower limb	151 (67.7)
Trunk	9 (4)
Type of orthopedic injury	
Compartment syndrome	97 (43.5)
Amputation	65 (29.1)
Fracture	57 (25.6)
Peripheral nerve injury	20 (9)
Soft tissue injury	12 (5.4)
Dislocation	2 (0.9)

the hands and feet. Survivors with soft tissue injuries were included in an electrotherapy program for pain management.

The locations of fractures are given in Table 3. The physical examinations of the patients with fractures revealed a reduction in joint range of motion and weakness. Those with extremity fractures did not require orthoses and were included in the physiotherapy program. Among patients with spinal fractures, five (55.5%) had SCI. Two patients with SCI, who had developed claustrophobia, began rehabilitation 13 months after the earthquake. The injury type among patients with SCI was paraplegia (complete in 40% and incomplete in 60%). Patients with complete paraplegia were provided intermittent clean catheterization training for neurogenic bladder by a rehabilitation specialist. Survivors with SCI required two wheelchairs and three mobility aids (Lofstrand crutches) for transfers. *Treatment for patients with fractures was terminated once healing was complete.*

Nerve injuries were primarily located in the upper extremities. Among the survivors, 11 had brachial plexus injuries, six had radial nerve injuries, one had an ulnar nerve injury, and two had sciatic nerve injuries (excluding nerve injuries due to compartment syndrome). *Although compartment syndrome is known to be associated with nerve damage, due to scar tissue from fasciotomies, electromyography could not be performed on these patients; therefore, their data were excluded from the study.* Brachial plexus injuries (54.5%) and radial nerve injuries (50%) were associated with humeral fractures. The physical examinations of survivors with nerve injuries revealed reduced joint range of motion, weakness, and sensory loss. Two survivors with radial nerve injuries required splints. Survivors with nerve injuries were enrolled in both physiotherapy and occupational therapy programs. *Anticonvulsant therapy was initiated in one (5%) survivor who developed neuropathic pain following a brachial plexus injury. While treatment for those with brachial plexus injuries continued, other survivors with peripheral nerve injuries achieved complete recovery.*

A total of 76 limbs were amputated among 65 survivors (Table 4). The amputations predominantly involved the lower extremities, particularly at transfemoral and transtibial levels. Prostheses were fitted, and training was provided for 37 amputees whose residual limbs were ready for prosthetics. *The prostheses included 21 transfemoral, 10 transtibial, two transhumeral, one shoulder, and two hip disarticulations, as well as one Chopart prosthesis.* Fifty wheelchairs and 10 mobility aids (crutches) were required for the transfers of amputees with lower limb amputations. Amputees were enrolled in an amputation rehabilitation program. *During follow-up, 33 amputees (50.7%) developed infections, and 45 amputees (69.2%) experienced phantom pain. Infection treatments were managed by infectious disease specialists, while medical treatment was recommended for phantom pain, although the patients declined to use it. Treatment for survivors without prostheses is ongoing* (Table 5).

Due to compartment syndrome, fasciotomies were performed on the legs of 72 survivors and the forearms of 27 survivors. Compartment syndrome in survivors resulted in weakness of the wrist and hand, foot weakness, reduced joint range of motion, sensory loss, and contractures. Seven splints, 39 ankle-foot orthoses, and nine foot-up orthoses were used. Six wheelchairs and 32 mobility aids (Lofstrand crutches and walkers) were required for transfers of survivors with compartment syndrome. These survivors were included in both physiotherapy and occupational therapy programs. *During follow-up, anticonvulsant therapy was initiated in 15 patients who developed neuropathic pain. Two survivors developed infections. A tendon rupture occurred in one survivor who underwent a forearm fasciotomy. Tendon transfer was performed on 12 patients, and tendon*

TABLE 3 | Fracture locations of earthquake victims.

Fracture locations	Number of patients (%)
Humerus	17 (29.8)
Tibia/fibula	13 (22.8)
Spine[a]	9 (15.7)
Lumbar vertebra	4 (7)
Thoracic vertebra	5 (8.7)
Cervical vertebra	1 (1.7)
Femur	5 (8.7)
Forearm	4 (7)
Others	9 (15.7)
Total	57 (100)

[a]One patient had a cervical and lumbar vertebra fracture.

TABLE 4 | Amputation levels of earthquake victims.

	Number of patients (%)
Transfemoral	40 (52.6)
Transtibial	21 (27.6)
Transhumeral	5 (6.5)
Shoulder disarticulation	4 (5.2)
Hip disarticulation	2 (2.6)
Transradial	2 (2.6)
Chopart	2 (2.6)
Total	76 (100)

TABLE 5 | Rehabilitation and orthosis-prosthesis needs of earthquake victims.

	Number of patients (%)
Physiotherapy	211 (94.6)
Occupational therapy	56 (25.1)
Amputee rehabilitation	65 (29.1)
Electrotherapy	12 (5.3)
Orthosis	
✓ Wrist splint	9 (4)
✓ Foot up	9 (4)
✓ Ankle-foot orthoses	39 (17.4)
Prosthesis	37 (16.5)
Wheelchair	58 (26)
Ambulation aids	45 (20.1)

lengthening surgery on three. The rehabilitation processes for these patients are ongoing.

4 | Discussion

The primary aim of this study was to investigate the types of orthopedic injuries among earthquake survivors requiring long-term rehabilitation. The results revealed that the most common injury requiring medical rehabilitation in earthquake-related injuries was compartment syndrome.

Li-Tsang et al. (2015) reported that the mean age of earthquake survivors seeking rehabilitation following the 2013 Ya'an earthquake was 41.4 (range: 6–87) years, with 76.2% between the ages of 18 and 64. The demographic data from our study indicated that the majority of the survivors were adults in their 30s. This finding suggests that the demand for adult rehabilitation units is higher than that for pediatric rehabilitation units after an earthquake.

Fractures, limb amputations, SCIs, soft tissue injuries, and peripheral nerve injuries are the most common types of injuries caused by earthquakes (Gosney et al. 2011). Guner et al. (2011) noted that during the 2011 Van earthquake, the most frequent injuries were soft tissue injuries (83.0%), followed by fractures (11.1%), compartment syndrome (6.2%), amputations (2.4%), crush injuries (1.8%), and nerve injuries (1.0%). Y. Li, Pan and Li (2009) reported that in the first month after an earthquake, 29.7% of fractures, 78.4% of amputations, 13.1% of spinal injuries, and 28.8% of peripheral nerve injuries required rehabilitation. Bilir et al. (2024) noted that fractures were the most commonly treated injury type requiring rehabilitation during the subacute phase following an earthquake. Since medical rehabilitation could not be provided in our hospital during the first 2 months, the types of injuries requiring acute rehabilitation remain unknown. In our study, the least common injuries requiring rehabilitation among earthquake survivors were soft tissue injuries and dislocations, suggesting that these injuries likely healed with acute intervention without requiring rehabilitation. We consider that the relatively low number of earthquake survivors requiring rehabilitation for fractures in our study may be due to successful surgical intervention or acute rehabilitation. The types of injuries that required long-term rehabilitation were compartment syndrome and amputation.

Pang et al. (2011) reported that lower extremity fractures were more common than upper extremity fractures in the 2009 Western Sumatra earthquake and that the most frequently affected areas were the tibia/fibula in the lower extremity and the hand in the upper extremity. In our study, the humerus was the most common localization for upper extremity fractures. The high rate of humerus fractures can be explained by the fact that 56% of these were accompanied by brachial plexus and radial nerve damage, which increased the need for rehabilitation.

Rathore et al. (2008) reported that paraplegia was the most common injury level in the 2005 Pakistan earthquake, with no cases of complete tetraplegia observed. In a study evaluating survivors from the 2010 Haiti earthquake, Rauch et al. (2011) determined that thoracic-level injuries were the most frequent spinal cord injuries, and complete injuries constituted the most prevalent type. In our study, the number of survivors with SCIs was low, which can be attributed to the possibility that patients sought rehabilitation at centers in neighboring provinces due to increased migration after the earthquakes. Consistent with the literature, most spinal fractures resulting in SCIs in our study occurred at the thoracic level, and paraplegia was the most common injury type. However, unlike the literature, incomplete injuries constituted the majority, a difference we believe may be due to the small number of cases in our study.

Amputee rehabilitation involves preventing stump infection, shaping the remaining limb through elastic bandaging, managing pain, and prescribing the most appropriate prosthesis once the stump is ready (Rathore et al. 2012). Common complications in amputee rehabilitation include skin problems (hyperhidrosis and allergic or contact dermatitis), contractures, infections, and phantom pain. Assistive devices such as wheelchairs, walkers, and crutches are essential to facilitate transfers and promote independence in activities of daily living (Knowlton et al. 2011). Y. Li, Pan and Li (2009) reported that most amputations requiring rehabilitation after the 2008 Wenchuan earthquake were transtibial and transfemoral amputations, with finger and toe amputations not typically requiring rehabilitation. Similarly, in our study, transtibial and transfemoral amputations were the most common levels requiring rehabilitation, and no amputees presented to the clinic for rehabilitation following finger or toe amputations.

Compartment syndrome following crush injuries, particularly in earthquakes, can result in limb loss and long-term functional deficits in the affected extremities (Bingol et al. 2023). *The infarction of muscle tissue leads to scar formation, shortening of the muscle, loss of elasticity, and adhesions to neighboring tissues (fibrotic scarring), resulting in contractures. In the long term, deformities such as pes equinovarus, claw toes, and hammer toes may develop in the lower extremity, while flexion contractures, known as Volkmann's ischemic contracture, may occur in the upper extremity* (Broadhurst and Robinson, 2020). Rehabilitation after fasciotomy includes passive stretching, strengthening, mobilization, splinting, and serial casting to maintain passive range of motion, prevent contractures, and increase muscle strength (Broadhurst and Robinson 2020; Hayashi et al. 2024). *When physiotherapy is insufficient to treat contractures, surgical procedures such as tendon lengthening, tenotomy, tendon transfers, and osteotomy may be planned (Santi and Botte, 1995). In our study, tendon lengthening and tendon transfers were performed in 13.4% of the patients who developed compartment syndrome*. To the best of our knowledge, no studies have examined the long-term rehabilitation needs of patients with compartment syndrome resulting from earthquakes. In our study, the most common injury requiring medical rehabilitation was compartment syndrome, with the leg being the most frequent site for fasciotomy.

The impact of medical rehabilitation has been observed in earthquakes in Haiti, Pakistan, and China (Rathore et al. 2008; Rauch et al. 2011; Landry et al. 2010). The destruction of institutions providing post-disaster rehabilitation services hinders the delivery of medical rehabilitation (Gosney et al. 2011). Li-Tsang et al. (2015) reported that after the 2013 Ya'an

earthquake in China, 79.7% of rehabilitation programs included physical therapy, 70.6% occupational therapy, and 6.3% orthotics and prosthetics [10]. As our hospital was affected by the earthquake, medical rehabilitation services could not be provided for the first 2 months. In addition, some survivors delayed seeking treatment due to claustrophobia. After the 2-month period, physical therapy became the most commonly applied treatment. The higher frequency of compartment syndrome and amputations in the lower extremities increased the need for assistive devices.

There are several limitations to our study, including the absence of pre- and post-treatment outcomes for the survivors, the retrospective study design, and the lack of assessment of the psychosocial problems experienced by the survivors.

4.1 | Implications for Physiotherapy Practice

Compartment syndrome is the most common injury requiring medical rehabilitation after earthquakes. Rehabilitation teams (physiatrists, physiotherapists, occupational therapists, orthotics, and prosthetics technicians) should be promptly dispatched to disaster zones, with a focus on lower extremity injuries requiring orthoses, prosthetics, and assistive devices. Considering the likelihood of local healthcare institutions in earthquake zones being affected by the disaster and the reluctance of survivors to enter enclosed spaces due to ongoing aftershocks, it is crucial to establish single-story rehabilitation centers in the disaster area as quickly as possible. Given the age distribution of the affected population, the number of adult rehabilitation centers should exceed that of pediatric rehabilitation centers.

Author Contributions

K.B. conception and design of research. E.A. design of research, data collection, drafted, edited and revised manuscript. All authors approved final version of manuscript.

Acknowledgments

The authors have nothing to report.

Ethics Statement

The study was approved by the Non-Interventional Research Ethics Committee of Hasan Kalyoncu University Health Sciences Faculty (2024/84).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

Permission to Reproduce Material From Othersources

The authors have nothing to report.

References

Afet ve Acil Durum Yönetimi Başkanlığı (AFAD). 2023. 06 Şubat 2023 Pazarcık-Elbistan (Kahramanmaraş) Mw: 7.7 – Mw: 7.6 Depremleri Raporu. 140 s.

Bilir, E. E., P. Borman, A. M. Ata, et al. 2024. "Clinical Properties and Rehabilitation Needs of Earthquake Survivors in a Subacute Rehabilitation Setting." *Turkish Journal of Trauma and Emergency Surgery* 30: 297. https://doi.org/10.14744/tjtes.2024.27553.

Bingol, O., T. Karlidag, O. H. Keskin, E. Kilic, B. Sarikaya, and G. Ozdemir. 2023. "Preventing Extremity Amputations After Earthquakes: A Quantitative Analysis of Fasciotomy and Extrication Time." *European Journal of Trauma and Emergency Surgery* 49, no. 6: 2515–2520. https://doi.org/10.1007/s00068-023-02325-6.

Broadhurst, P. K., and L. R. Robinson. 2020. "Compartment Syndrome: Neuromuscular Complications and Electrodiagnosis." *Muscle & Nerve* 62, no. 3: 300–308. https://doi.org/10.1002/mus.26807.

Gosney, J. E., J. D. Reinhardt, A. J. Haig, and J. Li. 2011. "Developing Post-Disaster Physical Rehabilitation: Role of the World Health Organization Liaison Sub-Committee on Rehabilitation Disaster Relief of the International Society of Physical and Rehabilitation Medicine." *Journal of Rehabilitation Medicine* 43, no. 11: 965–968. https://doi.org/10.2340/16501977-0890.

Guner, S., S. I. Guner, Y. Isik, et al. 2013. "Review of Van Earthquakes Form an Orthopaedic Perspective: A Multicentre Retrospective Study." *International Orthopaedics* 37, no. 1: 119–124. https://doi.org/10.1007/s00264-012-1736-x.

Hayashi, K., D. C. C. Chuang, T. N. J. Chang, and J. C. Y. Lu. 2024. "Functioning Free Muscle Transplantation to Restore Finger Movement for Sequalae of Volkmann Ischemic Contracture." *Hand Clinics* 40, no. 2: 269–281. https://doi.org/10.1016/j.hcl.2023.08.012.

Knowlton, L. M., J. E. Gosney, S. Chackungal, et al. 2011. "Consensus Statements Regarding the Multidisciplinary Care of Limb Amputation Patients in Disasters or Humanitarian Emergencies: Report of the 2011 Humanitarian Action Summit Surgical Working Group on Amputations Following Disasters or Conflict." *Prehospital and Disaster Medicine* 26, no. 6: 438–448. https://doi.org/10.1017/S1049023X12000076.

Landry, M. D., C. O'Connell, G. Tardif, and A. Burns. 2010. "Post-Earthquake Haiti: The Critical Role for Rehabilitation Services Following a Humanitarian Crisis." *Disability & Rehabilitation* 32, no. 19: 1616–1618. https://doi.org/10.3109/09638288.2010.500345.

Li, H., J. Nyland, K. Kuban, and J. Givens. 2018. "Physical Therapy Needs for Patients With Physical Function Injuries Post-Earthquake Disasters: A Systematic Review of Chinese and Western Literature." *Physiotherapy Research International* 23, no. 3: 1714. https://doi.org/10.1002/pri.1714.

Li, Y., F. Pan, and Y. Li. 2009. "Analysis of Rehabilitation Needs, Measures Taken, and Their Effectiveness for the Wounded Following the Wenchuan Earthquake." *Journal of Evidence-Based Medicine* 2, no. 4: 258–264. https://doi.org/10.1111/j.1756-5391.2009.01045.x.

Li-Tsang, C. W. P., C. Q. He, A. G. W. Lo, et al. 2015. "Rehabilitation Needs of the Survivors of the 2013 Ya'an Earthquake in China." *Journal of Rehabilitation Medicine* 47, no. 7: 586–592. https://doi.org/10.2340/16501977-1969.

Pang, H. N., W. Lim, W. C. Chua, and B. Seet. 2011. "Management of Musculoskeletal Injuries After the 2009 Western Sumatra Earthquake." *Journal of Orthopaedic Surgery* 19, no. 1: 3–7. https://doi.org/10.1177/230949901101900102.

Rathore, F. A., F. Farooq, S. Muzammil, P. W. New, N. Ahmad, and A. J. Haig. 2008. "Spinal Cord Injury Management and Rehabilitation: Highlights and Shortcomings From the 2005 Earthquake in Pakistan." *Archives of Physical Medicine and Rehabilitation* 89, no. 3: 579–585. https://doi.org/10.1016/j.apmr.2007.09.027.

Rathore, F. A., J. E. Gosney, J. D. Reinhardt, A. J. Haig, J. Li, and J. A. DeLisa. 2012. "Medical Rehabilitation After Natural Disasters: Why, When, and How?" *Archives of Physical Medicine and Rehabilitation* 93, no. 10: 1875–1881. https://doi.org/10.1016/j.apmr.2012.05.018.

Rauch, A., M. Baumberger, F. G. Moise, E. von Elm, and J. D. Reinhardt. 2011. "Rehabilitation Needs Assessment in Persons With Spinal Cord Injury Following the 2010 Earthquake in Haiti: A Pilot Study Using an ICF-Based Tool." *Journal of Rehabilitation Medicine* 43, no. 11: 969–975. https://doi.org/10.2340/16501977-0896.

Santi, M. D., and M. J. Botte. 1995. "Volkmann's Ischemic Contracture of the Foot and Ankle: Evaluation and Treatment of Established Deformity." *Foot & Ankle International* 16, no. 6: 368–377. https://doi.org/10.1177/107110079501600610.

Schultz, C. H., K. L. Koenig, and E. K. Noji. 1996. "A Medical Disaster Response to Reduce Immediate Mortality After an Earthquake." *New England Journal of Medicine* 334, no. 7: 438–444. https://doi.org/10.1056/NEJM199602153340706.

Sever, M. S., R. Vanholder, and N. Lameire. 2006. "Management of Crush-Related Injuries After Disasters." *New England Journal of Medicine* 354, no. 10: 1052–1063. https://doi.org/10.1056/NEJMra054329.

World Health Organization. 2013. Disaster, Disability and Rehabilitation. www.who.int/violence_injury_prevention/other_injury/disaster_disability2.pdf.

Zhang, X., X. R. Hu, J. D. Reinhardt, et al. 2012. "Functional Outcomes and Health-Related Quality of Life in Fracture Victims 27 Months After the Sichuan Earthquake." *Journal of Rehabilitation Medicine* 44, no. 3: 206–209. https://doi.org/10.2340/16501977-0945.