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Treatment of quadriplegia resulting from an accident through body engineering, hand therapy technique

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Abstract:

This case study explores the rehabilitation of a 42-year-old man who sustained a spinal fracture at the fourth lumbar vertebra (L4), leading to lower limb paralysis, loss of bladder and bowel control, and significant psychological distress after the garage door fell on his back. The primary objective was to achieve functional and psychological recovery through a structured rehabilitation approach. Following surgical stabilization, the patient underwent an intensive rehabilitation program incorporating body engineering and manual therapy techniques. The effectiveness of this approach was assessed using the Functional Independence Measure (FIM) scale, demonstrating notable clinical and radiographic improvements over 13 months, with a marked improvement in FIM scores related to transfers and mobility. Given the high incidence and economic burden of spinal cord injuries, this report highlights the potential of body engineering/manual therapy in post-surgical rehabilitation, contributing to improved physical, psychological, social, and occupational outcomes.

Keywords: Spinal Cord Injury (SCI), Quadriplegia, Rehabilitation, Body Engineering, Hand Therapy, Functional Recovery, Motor Skills, Functional Independence Measure (FIM).

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Introduction:

Workplace accidents are a significant cause of musculoskeletal injuries, often leading to severe complications such as fractures, spinal cord damage, and long-term disabilities. Among these, spinal fractures and vertebral injuries are particularly challenging due to their impact on mobility, organ function, and psychological well-being, with incidence rates ranging from 10.4 to 83 cases per million people annually (Wyndaele & Wyndaele, 2006). These injuries not only place a substantial burden on healthcare systems but also profoundly affect patients' quality of life, restricting their independence, limiting their ability to work, and increasing their reliance on long-term medical care. Spinal cord injuries (traumatic or non-traumatic) often result in partial or total loss of motor and sensory function, depending on the level of spinal cord involvement. Lumbar vertebra fractures, in particular, can lead to lower limb paralysis, loss of bladder and bowel control, and psychological distress. Moreover, research indicates that individuals who sustain a vertebral fracture are up to five times more likely to experience additional fractures (Luo et al., 2007).

As spinal cord injury care can be expensive and permanent disability is common, early intervention is necessary for optimal recovery outcomes. Although surgical stabilization is usually required for vertebral fractures, surgery does not guarantee full functional recovery. Rehabilitation is essential, as it promotes independence, mobility, and improved psychological well-being. Although there are continuing developments in patient rehabilitation, there still exists a gap in the evidence for post-surgical rehabilitation, especially for patients with lower extremity paralysis due to a fracture of a lumbar vertebra.

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Many studies are focused only on the surgical intervention and do not consider the rehabilitation approach that can impact the patient's functional recovery. This study aims to address this research gap by examining the role of body engineering and hand therapy techniques in post-surgical rehabilitation. Body engineering / hand therapy method approaches help to integrate physiotherapy and hand therapy techniques to enable neuromuscular recovery, increase mobility, and ultimately improve the patient's overall well-being while undergoing rehabilitation for spinal fractures. The primary objectives of this study are to identify the most effective rehabilitation strategies for patients with spinal fractures, examine the effectiveness of body engineering techniques on functional recovery after surgery, and assess the influence of mental health on rehabilitation. There is a psychological component to all medical interventions, and addressing these areas is of particular importance in an SCI (spinal cord injury) setting. This study aims to explore the interactions between physical rehabilitation approaches and mental health components in post-surgical patients to optimize rehabilitation outcomes. Ultimately, this work may provide future protocols to better the rehabilitation process and improve patient recovery outcomes and health-related quality of life for patients with similar injuries.

Research Problem:

Some studies have shown that rehabilitation and physical therapy are essential steps in the complete treatment of spinal and lumbar vertebrae fractures resulting from accidents, especially since vertebral fractures are a major cause for concern as they contribute to functional limitations, increase the risk of future fractures, and decrease life expectancy (Alexandru et al., 2012). However,

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studies related to these treatments are still relatively limited, and there remains a gap between surgical treatment and rehabilitation. This gap prompted the current research, which aims to answer questions related to rehabilitation based on body engineering techniques.

Research Questions:

The research attempts to answer the following questions:

• What is the impact of body engineering and manual therapy on functional recovery in a patient with L4/L5 spinal fracture and lower limb paralysis?

• How did the patient's Functional Independence Measure (FIM) scores change throughout the rehabilitation process?

• What psychological and physical improvements were observed during each rehabilitation stage؟

Research Objectives:

The primary objectives of this study are to comprehensively document and analyze the rehabilitation process of a 42-year-old male with an L4/L5 spinal fracture, focusing on the efficacy of a structured rehabilitation program incorporating body engineering and manual therapy techniques. Specifically, this research aims to evaluate the impact of these techniques on the patient's functional recovery, as measured by changes in the Functional Independence Measure (FIM) scores over a 13-month period. Additionally, the study seeks to detail the physical and psychological improvements observed during each distinct rehabilitation stage, providing insights into the patient’s progression from complete paraplegia to increased mobility. Ultimately, this report intends

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to contribute to the understanding of effective rehabilitation strategies for similar cases, potentially informing clinical practice and improving patient outcomes.

Research Significance:

This case study holds significant clinical relevance due to the complex fractures being life-altering injuries associated with significant morbidity, which places a large burden on health and social care resources. By exploring the efficacy of body engineering and manual therapy, this research contributes to the development of more effective post-surgical rehabilitation protocols. The findings have the potential to improve patient outcomes, enhance functional independence, and elevate the overall quality of life for individuals suffering from similar traumatic spinal cord injuries. Furthermore, this study underscores the importance of a holistic approach that integrates physical rehabilitation with psychological support, addressing the complex needs of this patient population and offering valuable insights for clinicians and rehabilitation specialists.

Research Methodology:

This case study employed a combined approach of body engineering and manual therapy techniques, tailored to the patient's specific needs and recovery stage. Body engineering, in this context, refers to a systematic application of biomechanical principles to optimize movement and function, focusing on posture, alignment, and efficient movement patterns. Manual therapy encompassed a range of hands-on techniques, including soft tissue mobilization, joint mobilization, and targeted stretching, aimed at pain reduction, muscle relaxation, and improved mobility. Ethical considerations were paramount throughout this study; written informed consent was obtained from the patient

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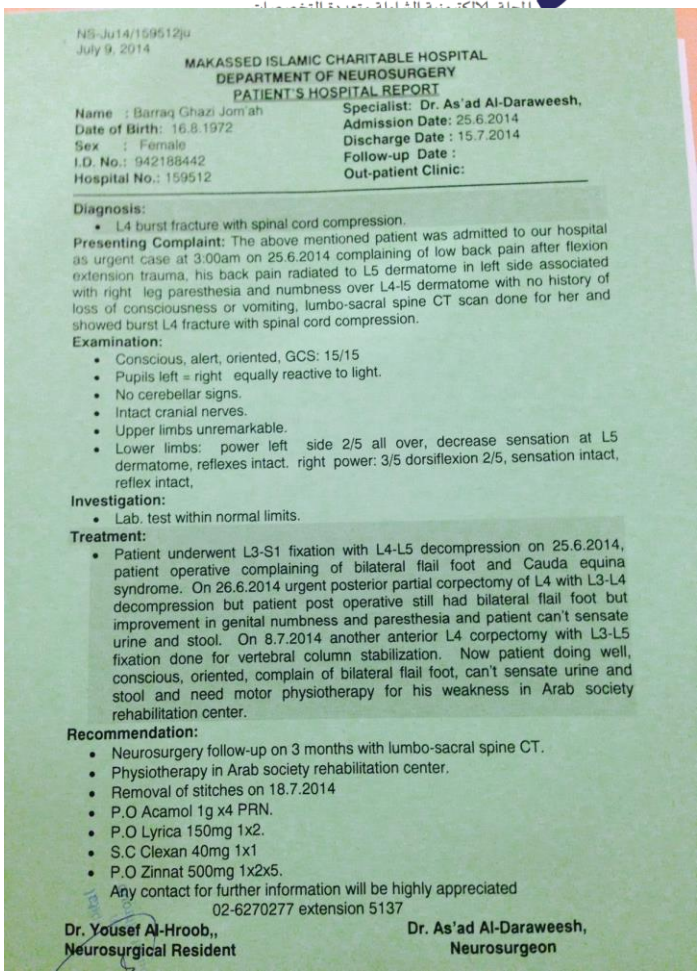
for publication of this report, including clinical details and attachments. All necessary measures have been taken to ensure that patient privacy is protected and that no identifying information is disclosed. This report is consistent with the ethical standards set forth in the Declaration of Helsinki. No Research Ethics Board (IRB) approval was needed as the report deals with an individual case, and consent was obtained directly from the patient.

Methods and Procedures:

This case report details the rehabilitation of a 42-year-old Palestinian male who sustained an L4 spinal fracture following a garage gate accident, resulting in lower limb paralysis, bowel and bladder incontinence, and psychological distress(See Figure 1/Figure 2). Following three surgical interventions (two posterior and one anterior spinal stabilization), the patient underwent a staged rehabilitation program designed to progressively improve functional abilities. The program combined manual therapy techniques with body engineering principles, focusing on pain management, muscle strengthening, mobility training, and psychological support.



NS-Ju14/159512ju
July 9, 2014

MAKASSED ISLAMIC CHARITABLE HOSPITAL
DEPARTMENT OF NEUROSURGERY
PATIENT'S HOSPITAL REPORT

Name : Barraq Ghazi Jom'ah
Date of Birth: 16.8.1972
Sex : Female
I.D. No.: 942188442
Hospital No.: 159512

Specialist: Dr. As'ad Al-Daraweesh,
Admission Date: 25.6.2014
Discharge Date : 15.7.2014
Follow-up Date :
Out-patient Clinic:

Diagnosis:
- L4 burst fracture with spinal cord compression.

Presenting Complaint: The above mentioned patient was admitted to our hospital as urgent case at 3:00am on 25.6.2014 complaining of low back pain after flexion extension trauma, his back pain radiated to L5 dermatome in left side associated with right leg paresthesia and numbness over L4-l5 dermatome with no history of loss of consciousness or vomiting, lumbo-sacral spine CT scan done for her and showed burst L4 fracture with spinal cord compression.

Examination:
- Conscious, alert, oriented, GCS: 15/15
- Pupils left = right equally reactive to light.
- No cerebellar signs.
- Intact cranial nerves.
- Upper limbs unremarkable.
- Lower limbs: power left side 2/5 all over, decrease sensation at L5 dermatome, reflexes intact. right power: 3/5 dorsiflexion 2/5, sensation intact, reflex intact,

Investigation:
- Lab. test within normal limits.

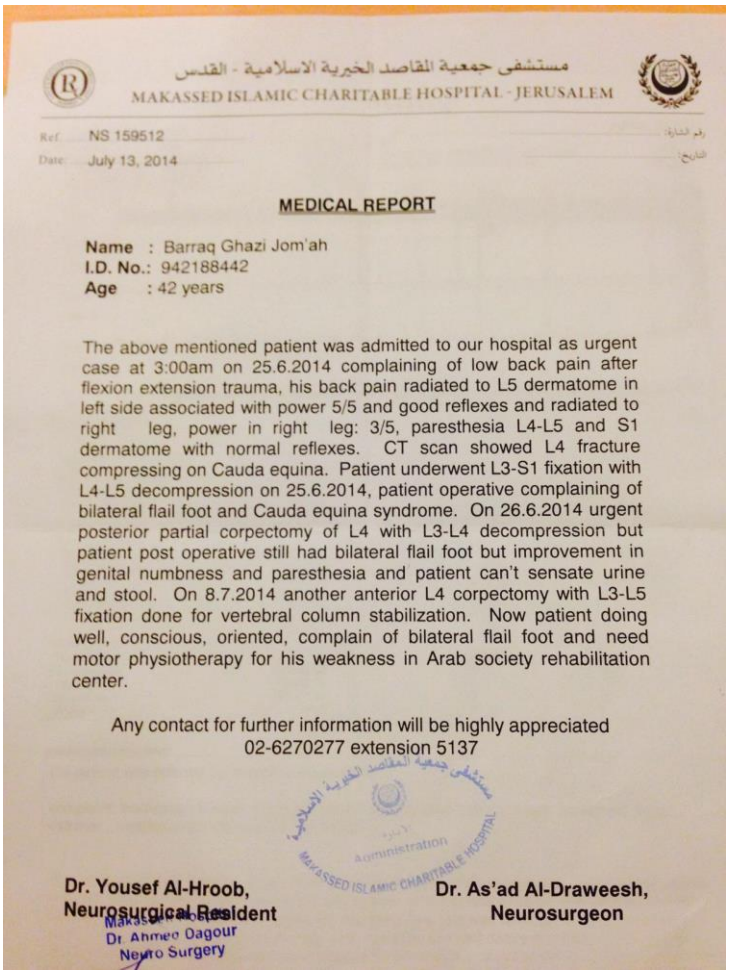
Treatment:
- Patient underwent L3-S1 fixation with L4-L5 decompression on 25.6.2014, patient operative complaining of bilateral flail foot and Cauda equina syndrome. On 26.6.2014 urgent posterior partial corpectomy of L4 with L3-L4 decompression but patient post operative still had bilateral flail foot but improvement in genital numbness and paresthesia and patient can't sensate urine and stool. On 8.7.2014 another anterior L4 corpectomy with L3-L5 fixation done for vertebral column stabilization. Now patient doing well, conscious, oriented, complain of bilateral flail foot, can't sensate urine and stool and need motor physiotherapy for his weakness in Arab society rehabilitation center.

Recommendation:
- Neurosurgery follow-up on 3 months with lumbo-sacral spine CT.
- Physiotherapy in Arab society rehabilitation center.
- Removal of stitches on 18.7.2014
- P.O Acamol 1g x4 PRN.
- P.O Lyrica 150mg 1x2.
- S.C Clexan 40mg 1x1
- P.O Zinnat 500mg 1x2x5.

Any contact for further information will be highly appreciated
02-6270277 extension 5137

Dr. Yousef Al-Hroob,, Neurosurgical Resident
Dr. As'ad Al-Daraweesh, Neurosurgeon

figure1



مستشفى جمعية المقاصد الخيرية الاسلامية - القدس
MAKASSED ISLAMIC CHARITABLE HOSPITAL - JERUSALEM

Ref. NS 159512
Date: July 13, 2014

MEDICAL REPORT

Name : Barraq Ghazi Jom'ah
I.D. No.: 942188442
Age : 42 years

The above mentioned patient was admitted to our hospital as urgent case at 3:00am on 25.6.2014 complaining of low back pain after flexion extension trauma, his back pain radiated to L5 dermatome in left side associated with power 5/5 and good reflexes and radiated to right leg, power in right leg: 3/5, paresthesia L4-L5 and S1 dermatome with normal reflexes. CT scan showed L4 fracture compressing on Cauda equina. Patient underwent L3-S1 fixation with L4-L5 decompression on 25.6.2014, patient operative complaining of bilateral flail foot and Cauda equina syndrome. On 26.6.2014 urgent posterior partial corpectomy of L4 with L3-L4 decompression but patient post operative still had bilateral flail foot but improvement in genital numbness and paresthesia and patient can't sensate urine and stool. On 8.7.2014 another anterior L4 corpectomy with L3-L5 fixation done for vertebral column stabilization. Now patient doing well, conscious, oriented, complain of bilateral flail foot and need motor physiotherapy for his weakness in Arab society rehabilitation center.

Any contact for further information will be highly appreciated
02-6270277 extension 5137

Dr. Yousef Al-Hroob, Neurosurgical Resident
Dr. As'ad Al-Draweesh, Neurosurgeon

Figure2

The rehabilitation program was divided into four phases: (1) Initial Recovery (1 month), (2) Core Stabilization (10 months), (3) Functional Progression (3 months), and (4) Final Recovery. The following describes the progression of exercise and therapy throughout these stages:

Stage 1: Initial Recovery: Focused on pain reduction using daily cryotherapy (15 minutes, twice daily), especially since topical cold treatment decreases the temperature of the skin and underlying tissues to a depth of 2 to 4 cm, decreasing the activation threshold of tissue nociceptors and the conduction velocity of pain nerve signals (Nadler et al., 2001), and ultrasound therapy (1

المجلة الإلكترونية الشاملة متعددة التخصصات
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MHz, 10 minutes), which is one of the most common physical agents used within physiotherapy practice in several countries (Bélanger, 2003). Basic muscle strengthening exercises (10 repetitions per set) and stand-pivot transfer training were initiated. No passive range of motion (ROM) exercises were performed for the hip and knee at this stage.

Stage 2: Core Stabilization: Introduced assisted ROM exercises for hips and knees, isometric exercises for hamstrings, quadriceps, and glutes, and partial weight-bearing ambulation using a walker.

Stage 3: Functional Progression: Implemented faradic current stimulation for muscle endurance (frequency: 60 Hz, duration: 0.1 ms to 1 ms, intensity increased gradually until a visible muscle contraction was achieved, while remaining comfortable for the patient). All these characteristics are associated with vasodilation, stimulating the metabolism of waste and toxins from the blood, increasing healing, and decreasing pain (Cheng et al., 1982), continuous passive motion heel and ankle pumps, progressive resistive isotonic exercises (e.g., quadriceps strengthening: 3 sets of 10 repetitions, increasing weight by 2 kg weekly), and partial to full weight-bearing activities. This stage was initiated after radiographic confirmation of bridging callus formation.

Stage 4: Final Recovery: Focused on strengthening exercises for quadriceps, hamstrings, and glutes, independent ambulation, and full weight-bearing, while avoiding torsional loads on the femur.

Duration of Treatment: Treatment sessions typically last 10 to 20 minutes.

المجلة الإلكترونية الشاملة متعددة التخصصات
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Results:

Following the treatment journey with the technique of body engineering and hand therapy, very satisfactory results were observed. The patient's condition progressed from wheelchair use and lower limb paralysis to walking with the help of one crutch. This demonstrated the accuracy of the treatment plan and the patient's commitment to executing the exercises. Effectiveness was measured using standardized assessments before and after the intervention, particularly the Functional Independence Measure (FIM), which is recommended by the Ministry of Health (Ministério da Saúde, 2006). At initial evaluation, the patient recorded an overall FIM score of 30, indicating significant dependence in all areas of daily living. After 13 months of intensive rehabilitation, the patient's overall FIM score increased to 95, reflecting significant improvement in functional independence (Uniform Data System for Medical Rehabilitation, 1997).

Conclusion:

This case report demonstrates the successful rehabilitation of a 42-year-old male suffering from severe quadriplegia, urinary and fecal incontinence, and significant psychological distress following a traumatic spinal fracture at L4/L5. The patient's condition, resulting from a garage gate accident, presented a complex challenge requiring a multi-faceted approach. Traditional surgical interventions were followed by a meticulous and progressive rehabilitation protocol based on body engineering and hand therapy techniques. The rehabilitation program, spanning 13 months, was strategically divided into stages, promoting progressive recovery. The successful outcome highlights the

المجلة الإلكترونية الشاملة متعددة التخصصات
Electronic Interdisciplinary Miscellaneous Journal
العدد الثاني والثمانون شهر 4(2025)
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potential for these techniques to enhance rehabilitation outcomes in similar cases, ultimately improving the quality of life for individuals suffering from traumatic spinal cord injuries. This report supports the importance of combining surgical interventions with comprehensive rehabilitation programs. In terms of functional status reflected by FIM motor scores, more significant improvements in FIM motor scores were found in ASIA grade D subgroups, consistent with previous findings in the Model Systems (Dijkers et al., 1995; Ditunno et al., 1995).

Study Limitations:

Despite the promising results of this study, it suffers from some limitations. First, the limited sample size (one case) limits the ability to generalize the results to larger groups of patients. There may also be factors other than therapeutic interventions that have contributed to improving the patient's condition, such as natural recovery or psychological and social support. Second, the lack of detail about Somatic Engineering and Manual Therapy protocols makes it difficult to replicate the interventions or compare them with other interventions. Therefore, future studies that include larger patient groups and provide a detailed description of the therapeutic interventions used are recommended.

المجلة الإلكترونية الشاملة متعددة التخصصات
Electronic Interdisciplinary Miscellaneous Journal
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