

Impact of an eye-tracking computer system on the life of a quadriplegic man in a rural town

Hilsenrath Lior; Ani Chisom; Cooper Jonah; Safadi Ali; Safadi Wajdi*

***Corresponding Author: Safadi Wajdi**

Department of Surgery, Clalit Health Services, Saudi Arabia.

Email: golancare@hotmail.com

Abstract

Individuals suffering from quadriplegia can experience feelings of hopelessness, leading to a myriad of emotional challenges such as depression, anxiety, and guilt. Previous studies have found that spinal cord injury doubled the risk of mental health disorders, and markedly increased the risk of suicidal ideation. Physical limitations, combined with subsequent decline in mental health, can further decrease rates of school enrolment and economic participation. The use and availability of technology to help stable quadriplegics live a happy and fulfilling life often depends on income, geography, and sociocultural factors. This case study examines the emotional impact of eye-tracking computer system technology in a quadriplegic man living in a rural and resource-limited town. We examine how this affordable technology helped give this patient newfound hope, and a second chance at emotional well-being.

Keywords: Depression; Spinal cord injury; Case study.

Background

Individuals with diseases and injuries of the high spinal cord can experience complete paralysis below the neck, and even become ventilator-dependent, resulting in an inability to use their voice to communicate [17,19]. Until recently, such dramatic physical limitations also led to limitations in one's ability to take advantage of otherwise intact cognitive functions to pursue activities such as higher education or pursuing a profession [10,15,18]. However, with the advent of Eye-Tracking Computer Systems (ETCS), patients with a myriad of disabling spinal cord conditions are able to effectively and easily read and write, maintain social communication, pursue degrees, make a living, and gain significant independence [16,19]. ETCSs work by projecting infrared light on the eyes. A sensor then analyses the position of the pupils and the infrared reflection from the cornea to precisely determine the location of the patient's gaze on a computer screen. This allows the patient to click buttons on the computer with their eyes, opening the door to typing, surfing the web, making phone calls, and other computer functions [19].

Case Presentation

In 2008, a previously healthy man presented to a clinic in a rural town with headache and neck pain. While being examined, he subsequently lost motor control and sensory perception below the neck. Subsequent studies in the hospital revealed a rare anterior spinal cord infarction at the level of C2, leaving the patient quadriplegic and respirator-dependent. A definitive cause for this event has never been ascertained, but was previously theorized to have possibly been a delayed reaction to minor and otherwise unremarkable trauma that occurred in a motor vehicle accident eight months prior.

After spending 3 months between a major hospital and rehabilitation center a couple hours away from his home-town, he ultimately returned home bedbound, with a percutaneous endoscopic gastrostomy tube, a suprapubic catheter, and a mechanical ventilator. He receives home-care from local medical staff, and his parents serve as around-the-clock caregivers, tasked with managing the ventilator, suctioning the tracheostomy, feeding and cleaning the patient, and providing physiotherapy. The costs associated with the patient's treatment are paid for in large part by the heavily subsidized healthcare system in Israel. Otherwise, he also receives financial and social support from a large extended family, friends, and the very tight-knit community at large.

As of January 2023, the patient has been paralyzed for the last 15 years of his life, but has only utilized the sophisticated eye-tracking computer system for the past 4 years. In discussion with the patient, he demonstrates many accomplishments, while also reporting a long and difficult journey to get to where he is today. In the first few years after the patient's vascular accident, he suffered from significant depression, and had thoughts of ending his life. Over several years, with the hard work and loving devotion of his family, the local clinic, and his tight-knit community, he became more optimistic about the future, and tried to focused on what he can do from his bed.

In the early years following his paralysis, the patient attempted the use of several less sophisticated assistive technologies to varying degrees of success, in order to aid communication. During this time, he remained completely dependent on his family to do such tasks as turning on the television or communicating with friends. Today, with ETCSs, he reports gaining significant independence. He is able to browse the web, play computer games, watch movies, read books, and text, call, and video chat with friends. The ability to easily communicate and connect with people, both within his home and across the country, has played a major role in improving his mood and general outlook on life as a quadriplegic. He also describes how the technology has allowed him to pursue his professional and intellectual interest in computer science. At the time of his accident, the patient had to put an indefinite hold on his college education. Today, he is actively pursuing a degree in computer science, proudly demonstrating his ability to fully engage in online courses at university. ETCS enables him to easily participate in online courses by rapidly producing text, quickly flipping through books and videos, and very effectively creating his own computer software using nothing but his gaze. He feels proud of these accomplishments and looks forward to working as a computer programmer in the future. This technology has given him a second chance at living a happy and fulfilling life, where he can continue to work, play, create, and connect.

Discussion

Although patients with diseases and injuries of the spinal cord face extreme challenges in activities of daily living, the use of cutting-edge eye-tracking computer technology drastically improves patients' mental health by offering independence, hope, and opportunity [13]. ETCSs allow them to practicalize their intact cognitive function, which has the additional benefit of reducing the likelihood of developing further disabling depression and anxiety [16,12,8].

The rural town in which this patient resides is by and large a resource-limited region, and is both geographically and culturally isolated. Making a living from work within the town can be difficult, and the costs associated with caring for a quadriplegic family member are high [4,5]. Indeed, the patient's father previously reported that the family only makes enough money to support the patient two-thirds of the month, and the rest of the much-needed resources are provided by the help of extended family members, friends, and the support of the local clinic [9]. One may naturally assume that such advanced eye-tracking computer systems are an expensive luxury of the rich, but fortunately, this revolutionary technology is relatively inexpensive, and currently available for as low as a few hundred dollars [7]. Thus, in contrast to many other medical devices and services that are highly inaccessible in resource-limited areas, ETCSs can more reasonably be obtained to improve the lives of quadriplegics in low-income families, towns, and countries across the world [2].

Our patient continues to receive strong familial and community support, including around-the-clock care from his mother, and significant household and vehicular modifications to provide the most accommodating possible environment. Yet in spite of all this, living with ventilator-dependent quadriplegia left him not only without the ability to freely ambulate, but stripped him of the use of his voice to effectively communicate, and rendered him socially isolated. Social isolation is a known major risk factor for depression, and a lack of social relationships have been shown to be extremely detrimental to well-being, and this is true both in and absent of spinal cord injury [6]. Conversely, social support, communication, and interaction have all been shown to increase life satisfaction, and decrease depression, helplessness, and pessimism, and thus should be highly encouraged in both short-term and long-term lifestyle planning by patients, their families, their physicians, and communities [14,11].

Paralysis and spinal cord injury can represent a colossal obstacle to many cognitive and intellectual pursuits, beyond physical. A lack of ability to seek education and employment adds to an overall loss of independence, self-esteem, opportunity for stimulation, and socialization [3,1]. Our patient was abruptly forced to discontinue university studies following his paralysis, potentially jeopardizing his chances at participating in higher education and having a professional life. Today, much of this has been ameliorated thanks to the use of life-changing ETCS technology. He has resumed his university education, and plans to pursue a career in computer science, embodying a success story about the culmination of individual efforts, community support, and technological advancements.

Learning points

- Quadriplegia can have serious consequences on mental health, and is associated with increased risk of depression, anxiety, and suicidal ideation.
- ETCSs enable paralyzed patients to perform most any computer function with only their gaze.
- ETCSs can significantly improve the mental well-being of paralyzed patients, and enables them to pursue higher education and a professional life.
- ETCSs are relatively inexpensive, and are reasonably attainable in low-income families, towns, and countries.
- Interaction and communication are crucial elements of well-being that should be heavily emphasized in individuals post-spinal injury.

References

1. Chapin MH, Kewman DG. Factors affecting employment following spinal cord injury: A qualitative study. *Rehabilitation Psychology*. 2001; 46: 400-16.
2. Compton B, Barash DM, Farrington J, Hall C, Herzog D, et al. Access to medical devices in low-income countries: Addressing sustainability challenges in medical device donations. *NAM Perspectives*. 2018; 8.
3. Crewe NM. A 20-year longitudinal perspective on the vocational experiences of persons with Spinal Cord Injury. *Rehabilitation Counseling Bulletin*. 2000; 43: 122-33.
4. DeVivo M, Chen Y, Mennemeyer S, Deutsch A. Costs of care following Spinal Cord Injury. *Topics in Spinal Cord Injury Rehabilitation*. 2011; 16: 1-9.
5. French DD, Campbell RR, Sabharwal S, Nelson AL, Palacios PA, Gavin-Dreschnack D. Health care costs for patients with chronic spinal cord injury in the Veterans Health Administration. *The Journal of Spinal Cord Medicine*. 2007; 30: 477-81.
6. Guilcher SJ, Catharine Craven B, Bassett-Gunter RL, Cimino SR, Hitzig SL. An examination of objective social disconnectedness and perceived social isolation among persons with spinal cord injury/dysfunction: A descriptive cross-sectional study. *Disability and Rehabilitation*. 2019; 43: 69-75.
7. Hanson S. Eye gaze finally affordable!. *MonTECH*. 2018 [cited 2023Feb5]. Available from: <https://montech.ruralinstitute.umt.edu/eye-gaze-finally-affordable/#:text=Now%2C%20thanks%20to%20innovation%20in,first%20affordable%20eye%2Dtracking%20system>.
8. Kaser M, Zaman R, Sahakian BJ. Cognition as a treatment target in depression. *Psychological Medicine*. 2016; 47: 987-9.
9. Litwak B, Dobie A, Safadi W. Lifestyle changes of a family caring for a 25-year-old quadriplegic man after delayed spinal cord infarction. *Case Reports*. 2015; 2015.
10. Man DW, Wong M-SL. Evaluation of computer-access solutions for students with quadriplegic athetoid cerebral palsy. *The American Journal of Occupational Therapy*. 2007; 61: 355-64.
11. Manns PJ, Chad KE. Components of quality of life for persons with a quadriplegic and paraplegic spinal cord injury. *Qualitative Health Research*. 2001; 11: 795-811.
12. McIntyre RS, Cha DS, Soczynska JK, Woldeyohannes HO, Gallagher LA, Kudlow P, et al. Cognitive deficits and functional outcomes in major depressive disorder: Determinants, substrates, and treatment interventions. *Depression and Anxiety*. 2013; 30: 515-27.
13. McKinley W, Tewksbury MA, Sitter P, Reed J, Floyd S. Assistive technology and computer adaptations for individuals with Spinal Cord Injury. *NeuroRehabilitation*. 2004; 19: 141-6.

14. Müller R, Peter C, Cieza A, Geyh S. The role of social support and social skills in people with spinal cord injury-a systematic review of the literature. *Spinal Cord*. 2011; 50: 94-106.
15. Ottomanelli L, Lind L. Review of critical factors related to employment after spinal cord injury: Implications for research and Vocational Services. *The Journal of Spinal Cord Medicine*. 2009; 32: 503-31.
16. Rigby P, Ryan SE, Campbell KA. Electronic aids to daily living and quality of life for persons with Tetraplegia. *Disability and Rehabilitation: Assistive Technology*. 2010; 6: 260-7.
17. Schilero GJ, Spungen AM, Bauman WA, Radulovic M, Lesser M. Pulmonary function and Spinal Cord Injury. *Respiratory Physiology & Neurobiology*. 2009; 166: 129-41.
18. Sturm C, Bökel A, Korallus C, Geng V, Kalke YB, et al. Promoting factors and barriers to participation in working life for people with Spinal Cord Injury. *Journal of Occupational Medicine and Toxicology*. 2020; 15.
19. Van Middendorp JJ, Watkins F, Park C, Landymore H. Eye-tracking computer systems for inpatients with tetraplegia: Findings from a feasibility study. *Spinal Cord*. 2014; 53: 221-5.

Manuscript Information: Received: July 03, 2023; Accepted: August 15, 2023; Published: August 23, 2023

Authors Information: Hilsenrath Lior¹; Ani Chisom¹; Cooper Jonah¹; Safadi Ali²; Safadi Wajdi^{3*}

¹Ben-Gurion University of the Negev Faculty of Health Sciences, Medical School for International Health, Saudi Arabia.

²University of Campania Luigi Vanvitelli School of Medicine and Surgery, Italy.

³Department of Surgery, Clalit Health Services, Saudi Arabia.

Citation: Lior H, Chisom A, Jonah C, Ali S, Wajdi S. Impact of an eye-tracking computer system on the life of a quadriplegic man in a rural town. *Open J Clin Med Case Rep*. 2023; 2095.

Copy right statement: Content published in the journal follows Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>). © **Wajdi S (2023)**

About the Journal: Open Journal of Clinical and Medical Case Reports is an international, open access, peer reviewed Journal focusing exclusively on case reports covering all areas of clinical & medical sciences.

Visit the journal website at www.jclinmedcasereports.com

For reprints and other information, contact info@jclinmedcasereports.com