# Mobilty Aid for Differntly Abled Persons - A Case Report

## Dr. Sumit Singh Phukela[*1], Dr. Omkar Krishna Shetty[2], Dr. Reshu Sanan[3], Dr. Pankaj Ritwal[4], Dr. Kunal Nischal[5], Dr. Diksha Singh[6]

[*1]Professor, Department Of Prosthodontics, Associate Dean Faculty Of Dental Science, SGT University, Gurgaon, India

[2]Dean , Faculty Of Dental Science, SGT University,

Gurgaon. Email ID: India dean.fdsc@sgtuniversity.org

[3]Professor Faculty Of Dental Science, SGT University, Gurgaon.

Email ID: India reshu.sanan@sgtuniversity.org

[4]Reader, Department Of  Prosthodontics , Faculty Of Dental Science, SGT University,

Gurgaon. Email ID: India pankaj.ritwal@gmail.com

[5]Senior Lecturer Faculty Of Dental Science, SGT University, Gurgaon.

Email ID: India kunalnischal_fds@sgtuniversity.org

[6]Senior Lecturer , Department Of Prosthodontics, Faculty Of Dental Science, SGT University, Gurgaon, India.

Email ID: diksha_fdsc@sgtuniversity.org

**\*Correspond Author:**

Email ID: sumit.phukela@sgtuniversity.org

## ABSTRACT

The problem being addressed is the lack of suitable mobility solutions for paraplegic and quadriplegic patients, particularly those with additional disabilities such as blindness, Parkinson's, or Alzheimer's disease. Conventional electric wheelchairs currently on the market are inadequate for individuals who cannot operate joystick controls due to paralysis or cognitive impairments.

Quadriplegic patients, who are paralyzed in both arms and legs, struggle to perform basic tasks such as movement. Approximately 20 per 100,000 people are quadriplegic, and existing solutions do not provide the necessary independence Similarly, paraplegic patients with blindness face difficulties navigating obstacles with conventional wheelchairs, affecting around 30 per 100,000 people Additionally, Parkinson's patients, who suffer from tremors and balance issues, cannot operate standard wheelchairs, affecting nearly 2 million people in India Alzheimer's patients, totaling 3.69 million in India, face challenges in remembering locations during routine movements The lack of appropriate technology that addresses these specific needs results in decreased independence, lowered

*Keywords: Artificial Intelligence , Mobility Assistance, Medical Devices , Quadriplegics.*

## 1. INTRODUCTION

Quadriplegics are persons who are not able to use any of the extremities. The reasons for such decreased motion possibilities can be different: stroke, arthritis, high blood pressure, degenerative diseases of bones and joints and cases of paralysis and birth defects. Quadriplegia is a spinal cord injury that causes paralysis after an accident[1]. Other causes include tumours or spinal cord diseases. The injury may cause partial or total limb paralysis (arms and legs). There are five different types of spinal cord injuries:

- **Complete spinal cord injury A:** this is the most severe type. The patient has no sensation or motor function below the injury.
- **Incomplete spinal cord injury B:** patient has some sensation. Motor function is limited below the injury.

Dr. Sumit Singh Phukela, Dr. Omkar Krishna Shetty, Dr. Reshu Sanan, Dr. Pankaj Ritwal, Dr. Kunal Nischal, Dr. Diksha Singh

- **Incomplete spinal cord injury C:** patient has some sensation and muscle control, but the muscles are weak and non-functional.
- **Incomplete spinal cord injury D:** muscles are 75% functional.
- **Incomplete spinal cord injury E:** minor injury. The patient has almost normal sensation and strength.

Conditions that could cause quadriplegia include; transverse myelitis, multiple sclerosis and Guillain-Barré syndrome[2]. The injuries may occur in children, before, during, or after birth. The most common cause is lack of oxygen in the brain due to poor oxygen supply.

Also, quadriplegia appears as age. The first thing that needs to be assessed is the injury location. Injuries higher up in the spinal cord tend to cause more paralysis issues. The most obvious symptom is limb deterioration, which can also affect torso function. This can cause the loss of control of several autonomic functions, including: Bladder and bowel, Loss of movement, Loss or change in sensitivity The general sense of feeling may be impaired in the affected areas, with symptoms including numbness, loss of sensitivity, or burning neuropathic pain. The patients with such severe disabilities are not able to perform their everyday actions, such as: feeding, toilette usage and movement through space. Depending on the severity of the disability, a patient can retain freedom of movement to a certain level by using different medical devices.[3]

There are two types of medical devices that enable independent movement to a person suffering from quadriplegia. Those are exoscelets and wheelchairs.

The need of this report is to ensure that the patient can drive this wheelchair on his own and can lead an independent and satisfied life and can carry his day to day tasks with full efficiency. This can enhance his quality of life and help him gain confidence.

## 2. CASE REPORT

A 40 year old male patient reported to the Department with the chief complaint of inability to move his extremities and inability of locomotion. On the external appearance, patient presented with presence of arms and legs but inability to move them. Patient also reported with symptoms of loss of sensation in arms and legs and inability to intentionally move arms and legs. On examination, diagnosis was made and treatment planning was done. An automated head movement and voice control wheelchair was designed for this patient to ease and enhance the quality of life of this patient. (FIGURE 1 )



**FIGURE 1 SMART WHEELCHAIR**

The following case report discusses the fabrication , function and patient satisfaction of this wheelchair.

A head movement of controlled wheelchair was planned for this quadriplegic patient. This head movement controlled wheelchair contains electronic systems which enables and improves a person's movement ability both in outdoor and indoor conditions[4]. Electronic systems such as sensors, actuators, communication modules and signal processing units, were used to recognize the activity that the patient was trying to perform and help him carry it out in coordination with the commands given by head movement. Head movement is a natural form of pointing and can be used to control this wheelchair which helps in movement[5]. Head movement : We have a special cap with an integrated motion or tilt sensor to sense the movement of the helmet and accordingly move the wheelchair in that direction. We can have forward, left and right movement. Wheelchair operation is based on navigation, which, in this case, is defined as safe transport from the starting point to a given destination.[6] For human-machine interaction human motion recognition is also used. [7-9] In such a situation we had prepared a system where patient can wear the helmet with attached head movement device. The movement of the

Dr. Sumit Singh Phukela, Dr. Omkar Krishna Shetty, Dr. Reshu Sanan, Dr. Pankaj Ritwal, Dr. Kunal Nischal, Dr. Diksha Singh

head controls the wheel chair direction. Microelectric mechanical sensor will translate the head movement into computer Interpreted signals. It then passes on data to the microcontroller. The microcontroller transfer signal to motor driven circuit which then control the wheel chair direction. [10]



**FIGURE 2  SENSOR MOUNTED CAP (WIRELESS )**

2.        Joystick control : We also have a joystick near the hand rest so that the user can control the wheelchair from the joystick conveniently. FIGURE 3



**FIGURE 3 JOYSTICK CONTROL**

3. Voice Control : The user can give voice commands like FORWARD, BACKWARD, LEFT, RIGHT and STOP to move in that particular direction. (FIGURE 4)
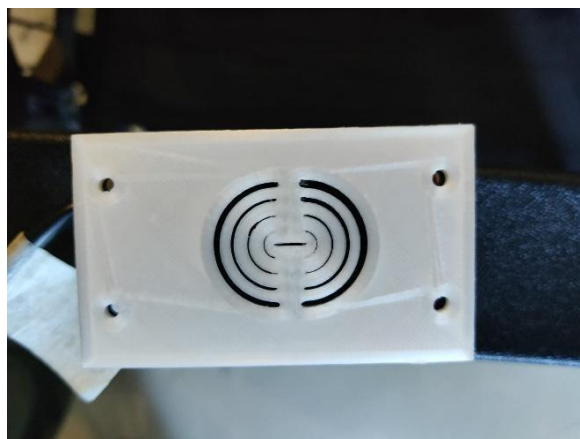


**FIGURE 4 VOICE MODULE IN OFFLINE MODE**

Dr. Sumit Singh Phukela, Dr. Omkar Krishna Shetty, Dr. Reshu Sanan, Dr. Pankaj Ritwal, Dr. Kunal Nischal, Dr. Diksha Singh

## 3. TARGET POPULATION FOR OUR INNOVATION

The primary beneficiaries of the smart wheelchair solution are individuals with severe mobility impairments, specifically paraplegic and quadriplegic patients, as well as those with additional disabilities such as blindness, Parkinson's disease, and Alzheimer's disease. These individuals often face significant barriers in performing daily activities due to their physical and cognitive limitations. For instance, quadriplegic patients, who are paralyzed in both arms and legs, will benefit from the head gesture and voice command controls that enable them to navigate independently

Paraplegic patients with blindness will also benefit greatly, as the integrated Braille system and obstacle detection features will allow them to move safely without relying on visual cues. Patients with Parkinson's disease, who suffer from tremors and balance issues, will gain from the wheelchair's stability features, which reduce the risk of falls Additionally, Alzheimer's patients will benefit from the GPS real-time location tracker, which helps prevent disorientation and allows caregivers to monitor their location in real-time

In the future, hospitals, rehabilitation centers, and disability care facilities will also benefit from offering this advanced mobility solution, as it reduces the burden on caregivers and enhances the independence of patients, ultimately improving healthcare outcomes.

## 4. DISCUSSION

Quadriplegic patients complaint of loss of sensation of inability to move their extremities. The foremost thing that has to be assessed is the site of injury causing loss of sensation of extremities. [11-15]One such case has been discussed in this case report. As this patient had reported, he was in a state of helplessness. This patient could not move his extremities and there was loss of sensation in the extremities. He was upset that he could not carry out daily tasks and had to be dependant on the attendants for the same. The quality of his life had been deteriorating and was guilty about it. A head movement and voice controlled wheelchair had been fabricated as discussed in this case report to fulfill the needs of helplessness. Slight angulation of head leads to the movement of the wheelchair in forward, left and right direction. When the head is held straight and still, the wheelchair comes back to the zero position and stops in the desired direction. An LED indicator has also been installed in this wheelchair for the patient's convenience. A manual joystick control has also been installed in this wheelchair. When the patient falls or becomes unconscious, this manual control unit can be immediately operated by the attendant to stop the wheelchair. This wheelchair provides an ease for the patient as well as the operator to operate this head movement-controlled wheelchair. The patient was recalled every 3 months to check the efficiency of the chair and repair any parts if needed. The patient was happy and stated that it has enhanced his quality of life and can carry out everyday tasks independently.

## 5. CONCLUSION

This innovative wheelchair integrates multiple advanced features to provide independence and improve the quality of life for individuals who cannot use traditional mobility aids.

Key features of the wheelchair include head gesture and voice command controls, which allow patients with limited physical abilities to maneuver the wheelchair without using their hands.

This multi-faceted solution addresses the specific challenges faced by different patient groups, offering them greater autonomy and dignity in their daily lives. The inclusion of emergency alarms further enhances safety, making the wheelchair a comprehensive mobility solution for patients with complex medical conditions

### EFERENCES

[1] . U. Cortés, C. Urdiales, R. Annicchiarico, C. Barrué, A.B. Martinez, C. Caltagirone: Assistive Wheelchair Navigation: A Cognitive View, Studies in Computational Intelligence: Advanced Computational Intelligence Paradigms in Healthcare – 1, Vol. 48, 2007, pp. 165 – 187.

[2] A. Landi: Update on Tetraplegia, Journal of Hand Surgery, Vol. 28, No. 3, June 2003, pp. 196 – 204.

[3] 3. N.I. Katevas, N.M. Sgouros, S.G. Tzafestas, G. Papakonstantinou, P. Beattie, J.M. Bishop, P. Tsanakas, D. Koutsouris: The Autonomous Mobile Robot SENARIO: A Sensor Aided Intelligent Navigation System for Powered Wheelchairs, IEEE Robotics and Automation Magazine, Vol. 4, No. 4, Dec. 1997, pp. 60 – 70.

[4] G. Bourhis, O. Horn, O. Habert, A. Pruski: An Autonomous Vehicle for People with Motor Disabilities, IEEE Robotics and Automation Magazine, Vol. 8, No. 1, March 2001, pp. 20 – 28.

[5] A. Lankenau, T. Rofer: A Versatile and Safe Mobility Assistant, IEEE Robotics and Automation Magazine, Vol. 8, No. 1, March 2001, pp. 29 – 37.

[6] M. Mazo: An Integral System for Assisted Mobility (Automated Wheelchair), IEEE Robotics and Automation Magazine, Vol. 8, No. 1, March 2001, pp. 46 – 56.

[7] H.A. Yanco: Wheelesley: A Robotic Wheelchair System: Indoor Navigation and User Interface, Lecture Notes

Dr. Sumit Singh Phukela, Dr. Omkar Krishna Shetty, Dr. Reshu Sanan, Dr. Pankaj Ritwal, Dr. Kunal Nischal, Dr. Diksha Singh

in Artificial Intelligence, Vol. 1458, Assistive Technology and Artificial Intelligence, Applications in Robotics, User Interfaces and Natural Language Processing, Berlin, Springer, Germany, 1998, pp. 256 – 268.

[8] C.H. Kuo, H.H.W. Chen: Human-oriented Design of Autonomous Navigation Assisted Robotic Wheelchair for Indoor Environments, IEEE International Conference on Mechatronics, Budapest, Hungary, 03 – 05 July 2006, pp. 230 – 235.

[9] J.M. Detriche, B. Lesigne: Robotic system MASTER, European Conference on the Advancements of Rehabilitation Technology, Maastricht, Pays-Bas, Holland, 05 – 08 Nov. 1990, pp. 12 – 15.

[10] J.L. Jaffe: A Case Study: The Ultrasonic Head Controlled Wheelchair and Interface, OnCenter: Technology Transfer News, Vol. 1, No. 2, 1990.

[11] R.C. Simpson, S.P. Levine: Voice Control of a Powered Wheelchair, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol. 10, No. 2, June 2002, pp. 122 – 125.

[12] P. Pino, P. Amoud, E. Brangier: A More Efficient Man Machine Interface: Fusion of the Interacting Telethesis and Smart Wheelchair Projects, 2nd International Conference on Knowledge-based Intelligent Electronic System, Adelaide, Australia, 21 – 23 April 1998, pp. 41 – 45.

[13] H.A. Yanco: Integrating Robotic Research: A Survey of Robotic Wheelchair Development, AAAI Spring Symposium on Integrating Robotic Research, Stanford, CA, USA, March 1998.

[14] M. Slavkovic, D. Jevtic: Face Recognition using Eigenface Approach, Serbian Journal of Electrical Engineering, Vol. 9, No. 1, Feb. 2012, pp. 121 – 130.

[15] S. Mitra, T. Acharya: Gesture Recognition: A Survey, IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, Vol. 37, No. 3, May 2007, pp. 311 – 324.