

*Case Report*

## **Effectiveness of Gel Seat Cushion on Pressure Ulcer and Metabolic Cost in Traumatic Paraplegic Person Using Manual Wheelchair- A Case Report**

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### **ABSTRACT**

Traumatic spinal cord injury (TSCI) is one of the most devastating types of injuries. As there is no cure for TSCI, prevention is critical. Paraplegic patient prefers wheelchair as a primary means of mobility. Wheelchair propulsion is more efficient than walking for people with extensive paralysis. Spinal cord injury patients prefer wheelchair for ambulation due to less energy expenditure and safety and speed ambulation. But Pressure ulcers are an underestimated healthcare problem, particularly for individuals with spinal cord injury who uses wheelchair regularly. Prevention of pressure ulcers, therefore, has not been given the appropriate high priority. Manual foldable wheelchair does not provide sitting stability which may increase metabolic cost of ambulation. This case report represents effectiveness of gel cushion on pressure ulcer and metabolic cost.

**Keywords:-** Traumatic Spinal Cord Injury, Manual Foldable Wheelchair, Pressure Ulcer,

### **INTRODUCTION**

Traumatic spinal cord injury (TSCI) is one of the most devastating types of injuries which results in varying degree of paralysis, sensory loss, and bladder/bowel dysfunction. [1] Spinal cord injuries typically are divided into two broad functional categories: tetraplegia and paraplegia. Paraplegia refers to complete paralysis of all or part of the trunk and both lower extremities (LEs), resulting from lesions of the thoracic or lumbar spinal cord or cauda equine. [2] According to the National Spinal Cord Injury Database (NSCID), motor vehicles accidents are the most frequent cause of traumatic SCI (45.6%), followed by falls (19.6%), acts of violence (17.8%), recreational sports injuries (10.7%), and other etiologies (6.3%). [3] People who have sustained a spinal cord injury, walking becomes less efficient and as the energy

cost of ambulation in spinal cord injury is too high other methods of mobility are sought. [4] Most patients with SCI will use a wheel chair as the primary means of mobility, even the patient with paraplegia who has mastered ambulation with crutches and orthoses will choose a wheelchair as a primary means of locomotion. [5]

High performance in wheelchair locomotion requires a combination of low energy cost and optimal comfort. Manual wheelchair propulsion by Hand rim is a means of locomotion with quite a high exertion demand. [6-8] Weak propulsive output is obtained with relatively high cardio respiratory stress. [9-10] use of seat cushions relieves pressure and reduce the risk of pressure sores in this population [11] as Prolonged sitting by a person in a wheelchair exposes that person to a high

risk of decubitus ulcers. [12] Use of seat cushion provides postural stability as well as pressure distribution which is may be related to the energy consumption.

### CASE REPORT

A 25 year old male patient with paraplegia using manual wheelchair as a primary means of mobility reported to the Department of Prosthetics and orthotics, National institute for Locomotor Disabilities, Kolkata, with chief complaint of frequent development of pressure sores at ischial tuberosity and early fatigue during wheelchair propulsion. On observation, patient was in wheelchair, patient body build was mesomorphic, and trunk was in slouched posture.

Patient examination:-

- Patient was using manual foldable wheelchair.
- Paraplegia
- Neurological level- T10,
- Asia scale- C
- No cardio respiratory problem
- No other associated neurological and orthopaedic problems
- Pressure ulcer grade 2 at ischial tuberosity.

**On history:-**

Patient met a road traffic accident before 1.5 years, after proper evaluation it was found that vertebral body fracture of T8, surgery was done for fusing the fracture site. Then he was taken to above mentioned hospital for rehabilitation. Manual wheelchair was provided for primary means of mobility.

**Present rehabilitation:-**

Patient came to the department with frequent development of pressure sore at ischial tuberosity and early fatigue during wheelchair propulsion. To reduce this problem contoured gel cushion was provided to patient. Energy expenditure was measured by Cosmed k4b2 metabolic analyzer before prescribing prefabricated contoured gel cushion during wheelchair propulsion. After providing the cushions, the patient was instructed to use the cushion

during wheelchair propulsion. Then the patient was called after a period of 2 weeks of use of the cushions and this 2 weeks time periods were given for adaption of seat cushion. After 2 weeks, post intervention data was collected during wheelchair propulsion.



Figure1. Manual Foldable wheelchair

**Specification of gel cushion:-**

A gel inner, enveloped in a vinyl cover, is contained within a foam border which is also covered in vinyl. The gel inner and the foam surround. The Gel –Seat wheelchair cushion is specifically designed to redistribute pressure to assist in the prevention of pressure ulcer while providing patient comfort can be used in wheelchairs or seats. This gel cushion consists of embedded gel insert which is localized gel in critical area evenly distributes weight and controls temperature, increasing comfort and reducing the possibility of pressure sore. Covering of high-technology composite foam conforms to body contours, distributes body pressure effectively by spreading weight over greater area, and prevents movement.

**Pressure ulcer:** Pressure ulcer was measured through observation of characteristics features of pressure ulcer. Pressure ulcer was also observed after 2 weeks use of contoured gel seat cushion. Grade II was clinically represented as abrasion or clear blister and ulcer is superficial without bruising. Grade I was clinically represented as discoloration of

skin at ischial tuberosity area as compared to the surrounding skin.



Figure 2- Contoured gel cushion

### Measurement of metabolic cost:-

Metabolic cost was measured by Cosmed K4B2 analyzer. The patients was normal psychologically with no anxiety, stress, fear etc. he was taught to propel the wheelchair with their own self selected speed and advised to take normal diet at least 2 days before the test. Patient was made to sit on a wheel chair. Height of the foot-rest was adjusted to have the thigh segment horizontal. The Seat angle was fixed at 0°, while the seat to back angle was at 95°.the patient was allowed 15mins of rest in the same position for stabilization of all parameters to be studied. All data of VO<sub>2</sub> max, oxygen consumption, and energy expenditure were recorded during wheelchair propulsion without cushion (pre-test) and with gel seat cushions (Post-test), once all the parameter had stabilized after 15 minutes of rest. Then the subject was asked to propel the wheelchair at self-selected speed on a 20 meter level surface. At first, parts of the Cosmed k4B2 analyzer were attached to the patient's body. Heart belt was fixed to the patient's box thorax and the K4 b2 unit was attached to the front of the harness. Battery was fixed at the heart belt on the subject's back. Then the battery cable was connected to the 6V plug of the K4 b2 control panel. Precaution was taken so that the red plug, that repairs the plug from water or sweat drops, was on the

Portable Unit side. Then the antenna cable was connected to the Antenna plug of Portable Unit control panel. The heart frequency receiver and temperature probe cable was inserted in the HR-Temp plug placed on the control panel and the male connector of the turbine was inserted in the Turbine plug on the control panel. After that the power supply cables, antenna and turbine on the right side of the jacket was fixed with the Velcro stripes provided in the equipment and the heart frequency probe was fixed on the left side.



Figure 3- patient propel wheelchair with gel cushion

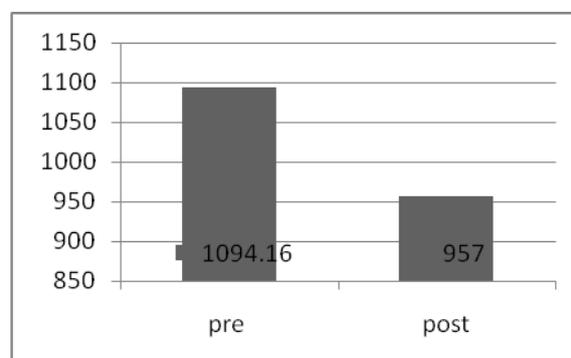
## RESULTS

Table 1- Showing ulcer gradation of pre and post intervention

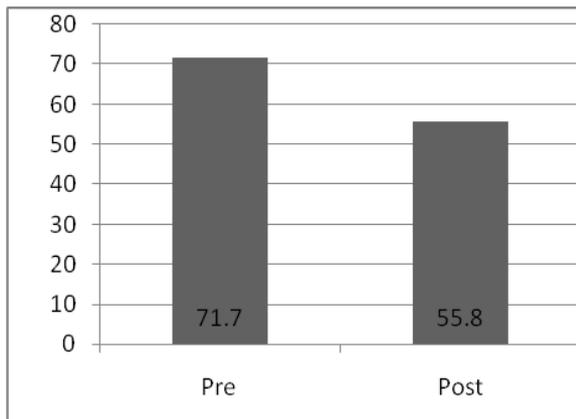
Pre-test pressure ulcer grade	Post- test pressure ulcer grade
Grade II	Grade I

Table 2- Showing comparison of VO<sub>2</sub> max, O<sub>2</sub> cost and energy expenditure of pre and post intervention

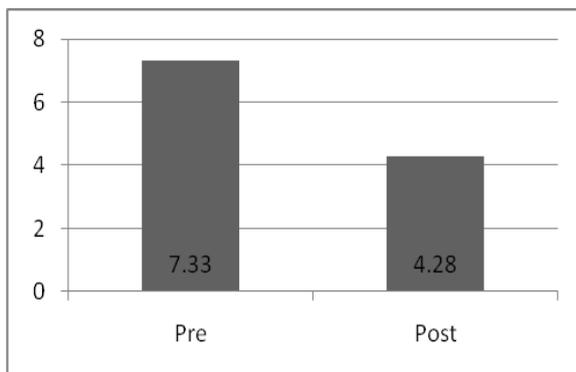
Value	VO <sub>2</sub> MAX (ml/min)	O <sub>2</sub> COST (mL/kg/m)	EE (Kcal/min).
Pre	1094.16± 0.763	71.7 ± 0.416	7.33 ± 0.152
Post	957 ± 0.901	55.8 ± 1.026	4.41 ± 0.249



Graph 1- Comparison of VO<sub>2</sub> max before and after use of gel cushion



Graph 2- Comparison of O<sub>2</sub> Cost before and after use of gel cushion



Graph 3- Comparison of energy expenditure before and after use of gel cushion

## DISCUSSION AND CONCLUSION

Wheelchair is the primary means of mobility in case of patient with spinal cord injury. A proper team approach is essential in providing accurate and effective rehabilitation and follow-up care for the patient. Persons with spinal cord injury have a reduced physical capacity because of muscle weakness, loss of autonomic control below the level of injury, reduced activity and subsequent changes in metabolic and vascular function. [13] Wheelchair cushions are frequently prescribed during the rehabilitation of individuals with paraplegia secondary to spinal cord injury. The primary purpose of these cushions is to relieve pressure under the person seated in a wheelchair and ultimately to reduce the risk of pressure sores.

Wheelchair cushion selection is important when an individual with a SCI is prescribed a Wheelchair. Bogie et al, (1995) noted that 47% of pressure ulcers occurred over the ischial tuberosity and sacrum and

are, therefore, more likely to have been initiated while the patient was seated. A cushion must keep direct pressures and shear forces low, but at the same time must be comfortable and provide stability. This gel cushion relieves pressure, provide sitting stability and prevent development of pressure ulcer. [11] Results of the study showed that there is improvement in VO<sub>2</sub> Max which was measured by ml/min was (1094.16 ± 0.763) before the use of gel cushion and reduced to (957 ± 0.901) ml/min. O<sub>2</sub> COST (mL/kg/m) was (71.7 ± 0.416) before use of gel cushion and reduced to (55.8 ± 1.026) after use of gel cushion. Energy expenditure was measured in Kcal/min and was (7.33 ± 0.152) and (4.41 ± 0.249) before and after use of gel cushion respectively. This may be due to gel cushion is more contoured. Sitting on a contoured cushion seemed to improve posture and balance when compared to the subject's regular cushion. This means that ideal pressure distribution is not difficult to achieve on Gel type cushion. As sitting balance is improved metabolic cost is also improved. Pressure ulcer is also significantly improved after use of gel cushions. One study revealed that use of cushion distributes pressure and reduce peaks caused by movements so that average pressure over time was minimized. In this case report we observed that the use of gel cushions in paraplegics using wheelchair increase seating stability, maintain postural alignment and prevent pressure sore. This may be due to better pressure distribution at ischial tuberosity and more sitting stability. From this study it can be concluded that the seat cushion system of wheel chair plays a vital role on the metabolic cost of paraplegic and no cushion or inappropriate seat cushion adversely affects the quality of life of individual.

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