

**Sports Instruction for Persons with  
Cervical Cord Injury**  
- Through Wheelchair Rugby -

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FOR PERSONS WITH DISABILITIES  
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**(WHO COLLABORATING CENTRE)**

March, 2020

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Rehabilitation Manual 35  
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-Through Wheelchair Rugby-  
March 31, 2020

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## **PREFACE**

Wheelchair rugby is a sport for quadriplegic athletes, for example, those with cervical cord injury. Which is why, the sport is also known as Quad rugby. Despite being a sport for athletes with such profound disabilities, wheelchair rugby is one of the most intense sports for persons with disabilities. Primarily rugby is a type of ball game but it is an intense sport with elements of combat sports like tackle and scrum. Similarly, there is tackling involved in wheelchair rugby as well with the sounds of colliding wheelchairs resounding in the building. In this sport there is something overwhelming about the drive of the charging athletes that gives the persons with severe disabilities a feeling that they have boundless possibilities.

On the other hand, wheelchair rugby is also rapidly gaining popularity as a sport that is intense, high-speed and fun. It is also gaining prominence because it is an official event at the Paralympics.

This manual was written by a staff member of the National Rehabilitation Center for Persons with Disabilities, who is also a qualified international referee for wheelchair rugby. This manual covers extensive information on wheelchair rugby, from elementary-level knowledge to technical matters that will be helpful for people intending to begin training as a wheelchair rugby athlete as well as for those interested in watching wheelchair rugby as a Paralympics sport. We hope this manual will help you understand and promote wheelchair rugby.

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## Introduction

Wheelchair rugby is an international wheelchair sport widely popular in the West. It was created in Canada in 1977 to provide an opportunity to persons with quadriplegia (persons with cervical cord injury, limb amputations, or disability of the limbs due to cerebral palsy, etc.) to participate in team sports. In America and some of the European countries it is also known as QUAD RUGBY as it is played by persons with disability involving all four limbs. Also, it was originally known as MURDERBALL due to the violent nature of the game. It was first introduced at the 1996 Atlanta Paralympics as a demonstration sport and became an official event from the 2000 Sydney Paralympics.<sup>1)</sup>

(In Japan, a federation (currently: Japan Wheelchair Rugby Federation) was established in April 1997 that ranked 8th in its Paralympics debut in the 2004 Athens Summer Olympics, ranked 7th in the 2008 Beijing Summer Olympics, 4th the 2012 London Summer Olympics and won their first medal with a 3rd position in their 4th successive participation in the 2016 Rio de Janeiro Summer Olympics.)

About 80% of the wheelchair rugby players in Japan are persons with cervical cord injury. According to a report by the Ministry of Health, Labour and Welfare of Japan (2008), there are about 24,000 persons with cervical cord injury (at home) across Japan. In persons with spinal cord injuries, including cervical cord injury, the remaining muscle mass and the degree of muscle strength may differ according to the difference in the level (high) and degree of injury (complete or partial), which can cause a significant difference in the activities of daily living they can perform. Similarly, when persons with cervical cord injury participate in sports, it is extremely important to assess their residual functions.

This manual classifies the impairment characteristics of persons with cervical cord injury together with providing a summary of the necessity, effectiveness, and points to remember about the sport for persons with cervical cord injury. In addition, the manual also introduces sports practices for persons with spinal cord injuries while focusing on wheelchair rugby which is the most popular sport among persons with cervical cord injury.

## **Chapter 1.**

### **Sports Instruction for Persons with Cervical Cord Injury (outline)**

#### **1. Impairment Characteristics of Persons with Cervical Cord Injury**

##### **1) What is cervical cord injury?**

Cervical cord injury is the disability caused by injury to the cervical cord. The spinal cord is linked to the brain and the medulla oblongata and serves as a neurotransmission pathway connecting the brain and the peripheral nerves. The spine is a column made up of 7 cervical vertebrae, 12 thoracic vertebrae, 5 lumbar vertebrae, 5 sacral vertebrae, and several caudal vertebrae. The vertebral column consists of a hole called the vertebral foramen that is enclosed by the anterior vertebral body and a posterior vertebral arch, and the connection of vertebral column forms the spinal canal. The spinal canal encloses the spinal cord and protects it from external forces. Any injury to the spine due to fracture or dislocation also injures the spinal cord. From both sides of each spinal segment of the spinal cord, peripheral nerves known as the spinal nerves branch out and are distributed throughout the limbs and trunk. The cervical spinal cord is formed of 8 spinal segments, and the 8 pairs of spinal nerves branching out from them are called the cervical nerves C1 (C: Cervical) through C8. An injury to the cervical cord can cause paralysis of the limbs and trunk. This is known as quadriplegia. When there is loss of movement or sensation, it is known as complete paralysis and when there is some or considerable residual movement and sensation, and the person is capable of voluntary movements, it is known as partial or incomplete paralysis.

##### **2) Motor paralysis**

When there is any damage to the spinal cord, which is the central nerve, due to any reason, the functions of the spinal cord at the damaged part are lost and so is the communication between the brain and the spinal cord parts below the injury site. As a result, injury of the cervical spinal cord leads to quadriplegia and injury of the parts below the thoracic cord lead to paraplegia (paralysis of both lower limbs). Again, which muscles get paralyzed depend upon the spinal segment of the spinal cord that is injured. This is expressed as the lowest spinal segment number in which has residual functions and is known as high-level injury. For example, injury to the fifth cervical cord (C5) would indicate that the functions up to the 5th cervical cord are remaining, while the functions from the 6th cervical cord are lost and movement of the shoulders and elbow bending is possible. In C6 injury, movements up to the dorsal flexion of wrist are possible, in C7, movements up to the extension of elbow are possible, and in C8, movements up to flexion of fingers is possible.

### **3) Sensory disturbance**

Somatic sensations consist of elements such as sense of touch, pain, warmth and position. The degree of sensory paralysis is examined to determine whether the senses are absent, dull, or on the contrary there is hypersensitivity. Generally, spinal cord injury presents with the same level of sensory disturbance as found in motor paralysis.

### **4) Autonomic dysfunction and reaction thereof**

Spinal cord injury impairs not only the motor and sensory functions but also the autonomic functions. Since the sympathetic nerves descend into the spinal cord from the hypothalamus through the brain, various sympathetic functions get impaired in response to an injured level. On the other hand, in the parasympathetic nervous system, majority of the thoracoabdominal internal organs are controlled by the vagus nerve which does not get damaged due to a spinal cord injury and therefore, the upper gastrointestinal tract functions are not affected. However, the sacral parasympathetic nerves that control the bladder and bowel get detached from the center, leading to severe bladder and rectal impairment. For the safety of sports, it is extremely important to understand that impairment of autonomic functions can impair the functions essential for maintenance of life, for example, functions regulating the blood pressure or body temperature or the excretion functions.

#### **(1) Orthostatic hypotension**

There are many persons with injury in upper than 5 to 6 thoracic spinal cords who regularly experience low blood pressure because the damaged sympathetic nerves impair the vasoconstrictor function in the lower limbs and the abdominal viscera. This is also associated with decrease in the volume of body fluids due to deconditioning or decline in pumping function of the skeletal muscle. Persons with cervical cord injury often experience orthostatic hypotension which can lead to fainting if the blood pressure falls very low. Such cases are gradually recuperated by lowering the backrest and bringing the head down, then lowering the head while bending the body forward and applying abdominal pressure using the body weight. Again, if there are problems with the hip joint, or if the legs cannot be bent forward, the person must breathe deeply while remaining in the wheelchair and then using both hands, apply pressure from the middle of the chest up to the abdomen using both hands by squeezing the body weight inwards while exhaling. Applying this kind of passive abdominal pressure a few times will also improve the condition. When experiencing orthostatic hypotension, one must stop all exercise and get some rest.

#### **(2) Autonomic hyperreflexia**

Autonomic hyperreflexia is observed in persons with spinal cord injuries affecting 5 to 6 thoracic cords or upper. Abnormal reflexive excitability of the sympathetic nervous system in 5 or lower thoracic cords that have separated from the central nervous system can cause sweating and headaches, sudden rise in blood pressure, bradycardia, flushing of the face, etc. This is caused by the



stimulation from the paralyzed regions, for example, fullness due to urine or stool, inflammation of the lower limbs, or trauma. It will last until the stimulus responsible for autonomic hyperreflexia is removed. It is important to pay attention to high blood pressure as it can cause fundus bleeding or intracranial hemorrhage.

### **(3) Disorder of thermoregulation (temperature instability)**

The vasomotor and sweating actions that regulate heat dissipation are severely impaired in persons with cervical cord injury. Also, there is reduced heat production and basal metabolism from muscle activity. This makes it difficult for them to adapt to the external temperature changes, making them susceptible to fever due to heat retention or extreme hypothermia. Accordingly, when playing in hot and humid conditions, try to restrain hyperthermia as much as possible by taking frequent rests, moistening the body with mist, cooling it down with coolants, drinking cold water, using the electric fan, moving to a place with air-conditioning, etc. Conversely, during cold weathers the body temperature cannot be maintained due to the influence of the outside temperature, therefore, it is necessary to move to a heated place before the body starts freezing.

### **(4) Urinal disorder**

Persons with spinal cord injury urinate using various techniques like intermittent urethral self-catheterization, reflex micturition, indwelling catheterization, and cystostomy. Inadequate management of urination can cause urinary tract infections or renal dysfunction, urinary tract stones, autonomic hyperreflexia, etc. It is necessary to make arrangements for regular urination even during a game. In addition, to ensure sufficient urine output, the standard water intake for persons with cervical cord injury is; 1500 cc in a day for people on urethral self-catheterization and 2000 cc per day for people using urination methods other than catheterization.

### **(5) Defecation disorders**

Persons with spinal cord injury have defecation disorders, which is why one of the biggest challenges of the chronic phase is abatement of constipation and incontinence. Although it may vary as per the individuals, one bowel movement may take up to 60 to 120 minutes. There can be incontinence of any remaining feces in unexpected situations like transfer from/to wheelchair/bed, etc., or upon bending forward, therefore take sufficient time to confirm that the evacuation is complete. Based on the dietary constituents, it may be necessary to use laxatives, suppositories, enema, stool extraction, etc. Players are required to manage defecation to match the schedule of activities like practice sessions or a game.

## **2. Focal Points about Sports**

### **1) Prevention of bedsores and decompression**

The protruding bony parts and parts having thin subcutaneous tissue like the muscle, fat, etc., are highly susceptible to bedsores. They are caused by continuous pressure and shearing of the skin. Bedsore is a complication that is easy-to-occur, difficult-to-cure, and likely to occur frequently. People without disability involuntarily keep changing their postures in order to avoid numbness and pain, thereby preventing occurrence of bedsores, but there are no preventive measures for persons with spinal cord injuries and because of their paralysis or numbness, they have to be moved and given regular decompression. Bruises, scratches, skin injury, blisters, folliculitis, unclean body parts, infections, etc., can also cause bedsores and therefore it is important to spread awareness on always keeping the skin clean and give guidance on preventing external injuries while playing. Also, poor posture due to joint contracture or deformity, spinal column scoliosis, pelvic inclination, etc., can lead to local compression or shearing, which is why it is important to maintain an appropriate posture in everyday life, even when lying in bed or sitting in the wheelchair. In sports practice, people tend to focus more on strengthening the remaining physical functions, but it is important to further strengthen one's ability of taking care of the everyday physical condition for which it is essential to make it an everyday habit to perform skin checks, do frequent pushups, and postural changes.

During physical training, there is automatic and repetitive decompression and pressurization of the buttocks due to the constant movement of the upper body; therefore there is no need for deliberate decompression. However, during breaks it is necessary to make it a habit to perform regular decompressions. In addition, the wheelchair cushion covers and uniform pants should ideally not be made from slippery materials as bruises from falling down can also cause bedsores.

### **2) Hypoglycemic state**

Many persons with cervical cord injury eat very small meals as their sensation of hunger is dull. Skipping breakfast or rushing to practice after the day's work causes decline in the sugar content in the blood, which is the source of energy. This can cause temporary hypoglycemia (low blood sugar) with symptoms similar to cerebral anemia. Since physical training requires much more energy expenditure, it is necessary to reinforce the sugar content prior to exercise. Since it is not always possible to have a proper meal during a practice session or a match, or while driving an automobile, it is necessary to carry temporary sources of sugar, for example bananas and rice balls.

## **3. Effectiveness and Necessity of Sports**

### **1) Effectiveness of sports**

Sports are considered to be synonymous with various physical activities and have been used since the ancient times as a means of health preservation and promotion. Based on the purpose, sports can be classified into two categories; sport as a hobby or recreational activity, athletic sports as competitive matches like the Olympic Games which were the mainstream up to the 19th century, and sports for the

new purpose of health promotion, improving the daily living ability, prevention of illness, etc., that gained prominence as we entered the 20th century. While the former requires high level of systematic implementation of skill and rules, the latter requires low level of the same and have considerable attributes of playing. In either case, sports is a physical activity for healthy development of the mind and the body, and is particularly helpful as one of the means of providing physical, mental, and social rehabilitation for persons with disabilities while contributing to their fitness, that is to say, for achieving a state of mind and body equilibrium. Besides, sports give an opportunity to people to come in contact with others and forget their problems and act and behave in ways they normally do not act when struggling with their problems alone. This self-expression and observing self-expression of other people heightens the interaction with others, and doing something that one does not normally do makes one more aware of their own as well as other peoples' hidden abilities. In this way sports can become one of the tools of bringing out various capabilities of people. A characteristic of sports is that it helps bring out capabilities of people that are not normally seen through physical experiences a person does not experience every day, which can be very uplifting. Sports are thus linked to improving the capabilities of the people engaged in them. Since many games are played in groups, in the initial stages of rehabilitations people who tend to be in isolation can expose themselves to similar people through sports and form natural relationships.

Having a disability can make a person feel handicap. To persons with disabilities, the surrounding people and environment can also seem like barriers. It seems that persons without disabilities and even persons with disabilities have stereotypes that persons with disabilities may not be able to play sports. Indeed, when there is a lack of contraptions, it can be said that it is difficult for persons with disability to participate in sports. Technically sophisticated people can provide contraptions to enable persons with disabilities to participate in sports.

Persons with cervical cord injury due to trauma, etc., are unable to properly use their bodies like they were used to since many years, and have to go through motor learning to know their bodies again. In such situations, incorporating the necessary rehabilitation programs in sports can help such people in getting to know and use their bodies again. Being able to skillfully use one's body makes a person more self-confident, more active, and proactive in interacting not only with oneself but also with others. Also, some persons with disabilities are very keen in sports activities, with some finding a friend in sports similar to some persons without disabilities who engage in sports all their lives as a hobby.

## **2) Necessity of sports**

### **(1) Medical care / welfare and sports**

Physical therapy and occupational therapy are the typical forms of rehabilitation for persons with disabilities. By receiving such type of functional training, the target persons can improve their ADL (activities of daily living), thereby achieving the biggest purpose of rehabilitation. Since physical therapy and occupational therapy provide training in a form connected with the actual ADL, they can

actually make the target persons feel that the training is specifically progressing toward achieving their own goals. While on the other hand in sports, since the technique itself is based on exercise and sports, it may be difficult to find a direct relation with ADL training. However, sports are also said to be the power behind the scene as they help create bodies that can skillfully perform ADL. In physical therapy and occupational therapy, specific ADL goals are set and functional training and capability development are implemented for parts required for achieving these goals. More specific, clear and efficient training can be developed but it cannot be said that movements not related to ADL are adequately incorporated in the rehabilitation programs. In case of a person with midlife disability, injury and illness can cause physical disability. Due to functional impairment, the parts they had been using their entire life stop functioning, requiring them to re-program their bodies they had been used to. Just like children learn to understand their bodies through play, despite being adults, persons with disabilities also have to understand their bodies again through actively moving their bodies in order to reconstruct their bodies. From this point of view as well, it is possible to re-program one's body by suitably pursuing a sport. For this reason, it is important to try different types of exercises. Having a wide range of exercise experience not only further ascertains ADL movements but also plays an important role in drawing out more possibilities in the long life that follows.

## **(2) Community and sports**

Sports play a leading role on the regional level. In the initial days of sports for persons with disabilities, there were very less options as most of the sports for persons with disabilities leaned heavily towards competitive sports. In the recent years, the taste of the general public in sports has also diversified and the environment of sports is being modified to individual tastes. Although somewhat lagging behind in moving towards this new environment, persons with disabilities are also now getting engaged in various forms of sports like lifelong sports and sports for health preservation and not just competitive sports. Implementation of competitive and lifelong sports is a community-based activity. There are many community instructors for sports for persons with disabilities as well as general sports instructors providing coaching based on their respective expertise. Those specializing in sports for persons with disabilities pursue the great mission of returning to the community for creating active opportunities for such activities. Therefore, one must try to improve one's physical ability by exposing oneself to many exercise experiences so as to have a wider range of options to select from. At the same time, it is important to find out the preference and capability of the target persons and provide information on the sports suitable for them. Also, when persons with disabilities wish to engage in a sports activity in the community, by providing the appropriate information after determining the situation of activities in the community and the lifestyle of the target persons wanting to pursue the activities can enable them to smoothly join the local sports activities.

### **(3) Health promotion and sports**

Lifestyle diseases are universally becoming a major health problem. This problem is a result of an imbalance between the calories consumed and the calories expended, for which the general recommendation is - diet therapy and exercise. Depending on the degree of disability, most of persons with disabilities persons tend to consume fewer calories as their residual functions are less compared to those of persons without disabilities. A handicap can also cause restrictions for people in leaving the house, forcing them to spend the whole day at home. This can further reduce the calorie expenditure and make them susceptible to lifestyle diseases. There are great challenges in sports when it comes to getting persons with disability to take up exercising for physical movement, making physical movement fun for them and if possible, getting them interested in lifelong sports. However as discussed earlier, having a disability reduces the residual functions and since fewer calories are expended despite exercising, consuming the same amount of food as earlier will be more than requirements of the body. In such cases, it is necessary to consult a registered dietitian.

## Chapter 2.

### Practical Skills for Wheelchair Rugby (actual practice edition)

#### 1. Overview of Wheelchair Rugby

##### 1) Characteristics of sports

Wheelchair rugby is a mixed-gender sport with up to 12 players in a team with only four players from each team allowed to be in the court at any time. There is a point system wherein the total number of points for the 4 players of a team on the court must not exceed 8 points. The assigned points are classified into 7 classes in the increments of 0.5 points based on the level of disability of the players, with 0.5 class having athletes with the most disability and 3.5 class having athletes with the least disability. Assigning a maximum of 8 points for a total of 4 players on the court, gives an opportunity to all the athletes, with minimal to severe disabilities, to compete. Also, 0.5 points are subtracted for each female athlete.

Each game consists of four eight-minute periods, with there being intervals between each period. If there is a tie at the end of the 4th period, 3-minute overtime periods are played to decide the outcome.

The court is the same size as the basketball court and there are rules for restricting the attack time, etc. Wheelchair rugby uses a specially designed ball developed based on volleyball no. 5. For a goal to count, two wheels of the wheelchair must be on or have crossed the goal line while the player has possession of the ball.

Wheelchair rugby is a unique sport created for athletes with disabilities having mixed elements of rugby, basketball, handball, and ice hockey.

##### 2) Wheelchair features

There are mostly two types of wheelchairs used in wheelchair rugby, those for high pointers and for low pointers (Pictures 1-1, 1-2). In wheelchair rugby, there can be extensive damage due to tackling, as physical contact between the wheelchairs is permitted. The wheelchairs of top athletes



Photo1-1



photo1-2

who participate in international events may require repeated welding for cracks etc., and may lose their original performance in about 2 years as the frame gets deformed. In other wheelchair games, the wheelchairs are required to be lightweight but wheelchairs for wheelchair rugby are required to have maneuverability and speed not required in other wheelchairs, and they also need to be somewhat rigid (strong) and heavy. If the wheelchair is too light, the player can be flicked off upon contact with another wheelchair and lose their dominant position or may simply get tripped up and fall down.

## **2. Introduction of Wheelchair Rugby**

Wheelchair rugby players are assigned points according to the degree of their disability. Points are determined based on the results of muscle strength test, trunk function test, movement function test, and by observing their game, and are classified into 7 classes in the increments of 0.5 points, with 0.5 for athletes with the most disability and 3.5 for athletes with the least disability. In this manual, we shall explain the introduction part by classifying the class of players into low-pointers or players assigned between 0.5 to 1.5 points, and high-pointers or those assigned between 2.0 to 3.5 points.

### **1) Preparation**

#### **(1) Gloves and taping**

Both hands of the players are constantly engaged in running and manipulating the wheelchair, as well as driving and braking due to change in the course. Therefore, efforts should be made to prevent scalding caused by abrasion and friction of both the upper limbs having sensory disorders, to stabilize the wrist joints that are exposed to excessive range of motion from overuse in daily life, and to prevent sprains in fingers due to contracture deformities. This is why gloves and taping are indispensable. Make sure that the gloves are made of a material that provides sufficient grip and proper torque transmission. Although taping is a necessary measure for protecting paralyzed upper limbs, it must be noted that very tight taping can cause ischemia. The type and usage method of gloves and taping may vary for low and high pointers as per their residual functions.

### (I) Low pointers

Primarily there are 2 types of gloves for low pointers (Pictures 2-1, 2-2). Also, just wearing the main gloves has a high possibility of causing scratching of the palms, therefore before wearing the gloves, the parts prone to scratches must be protected with taping and then a thin inner must be worn (Pictures 2-3, 2-4). The next section describes method of wearing gloves and securing the tape. Persons with severe cervical injuries and beginners may find it particularly difficult to wear the gloves on their own and may require assistance. This paragraph introduces the method of assisting players with wearing the gloves. First, turn the glove inside out up to half of its length (Picture 3-1), insert all 4 fingers except the thumb till the deep end (Picture 3-2), turn the glove over while holding down the fingers (Picture 3-3), insert the thumb (Picture 3-4), insert all 5 fingers all the way in (Picture 3-5). Finally, make sure that all the fingers are fitting properly (Picture 3-6). Next, the purpose of taping is to protect the parts that are exposed to frequent friction while operating the wheel, and the parts with thin muscle layers. After wearing the gloves, tape the gloves so as to hold them in place to protect the arms.



photo2-1



phoro2-2



photo2-3



photo2-4





photo3-1



photo3-2



photo3-3



photo3-4



Photo3-5



photo3-6

## (II) High pointers

The purpose of gloves and taping for high pointers is same as that of low pointers. The high pointers need to wear fitted gloves in order to facilitate passing or catching the ball (Picture 4-1). Moreover, some high pointers also use rubber to protect their palms and for making it easier to apply strength on the wheel as they have more strength for operating the wheel compared to the low pointers (Picture 4-2).



Photo4-1



photo4-2

## (2) Protectors

In wheelchair rugby, tackling is permitted from directions. In particular, when a high pointer player is holding the ball and an opponent is trying to take it away, the player may try to pass the ball by drawing the opponent as close as possible, and during this the player who is being tackled more forcefully may lose their balance and overturn. Since the player falls while holding the ball, their elbow or knee are more likely to hit the ground before the fingers. Since the sense of pain is absent in completely paralyzed athletes, any injury to the knee may not immediately get noticed. From the point of view of preventing a sports injury, it is recommended to wear protectors for protecting the elbows and knees (Picture 4-3).



Photo4-3

### (3) Transfer

The method of transfer from a regular wheelchair to a rugby wheelchair is also a little different for low pointers and high pointers.

#### (I) Low pointers

Low pointers with 0.5 points etc., find it difficult to transfer by themselves and require a transfer device (Picture 5-1). Using such a device, only one helper is sufficient for carrying out the transfer. The player moves the wheelchair to the transfer device and applies the brakes (Picture 5-2). Lowers both legs and inserts both the hands between the belt (Picture 5-3). The helper raises the wheelchair diagonally towards the front from behind (Picture 5-4). The player bends both elbows up to 90 degrees. The helper replaces the regular wheelchair with the rugby wheelchair. The helper inserts a bumper between the legs from the front. The player recovers the seat. The player inserts both the legs and wears the belt.



photo5-1



photo5-2



photo5-3



photo5-4

## (II) High pointers

The high pointers are able to transfer themselves. Here, we shall explain the transfer of high pointers who are beginners. As a preparation for transfer, press the rear of the rugby wheelchair against a wall. Park the regular wheelchair in contact with the front side of the rugby wheelchair and put on the brakes (Picture 6-1). Securing the rugby wheelchair at 3 points like this prevents transfer failures (falls). Next, the player moves the buttocks as much towards the edge of the seat as possible and lowers both the legs. Then places one hand on the frame of the rugby wheelchair while the other on the regular wheelchair (Picture 6-2). And this way transfers from a regular wheelchair to the rugby wheelchair (Picture 6-3). If the player is unable to transfer in one step, they can lower the buttocks between the middle of both the wheels and transfer in two steps (Picture 6-4). In this case, they must take care against injuring the buttocks. And this way the player transfers from a regular wheelchair to the rugby wheelchair (Picture 6-5). Transfer of high pointers is not just dependent on functional elements like strength and residual function of upper limbs, but the physical factors like length of arms, body weight, etc., timing, speed, position of



Photo6-1



photo6-2



photo6-3



photo6-4



Photo6-5

hand and buttocks, etc., are also important. It is important to practice repeatedly to find your own safe transfer method.

#### **(4) Wheelchair adjustments**

##### **(I) Height of back seat**

Persons with complete cervical cord injury lack the ability to balance themselves in the sitting position due to trunk muscle paralysis and thus maintain balance by reclining on the backrest of the wheelchair. A very high backrest may restrict the movement as the upper arms or shoulders can get hit against it, causing external wounds and bedsores. A very low backrest will not be able to add stability to the trunk. Setting the proper height will maintain a good sitting posture and prevent the trunk from bending backwards or falling sideways. Also, the height should not restrict the movement of the shoulder blade.

##### **(II) Backrest angles**

If the backrest is heavily inclined backwards, it may lead to permanent hump back. A player with a hump back has restricted control on the upper body which reduces their ability to row, and deteriorates their control over the ball. It also increases the risk of falling backwards. If the backrest angle is too small, the trunk will frequently tumble forward while the wheelchair is moving. Since sports wheelchairs have stationary-type bodies, they cannot be causally repaired or adjusted. Therefore, the angle of the backrest should be decided based on the use of belts for the pelvic region, abdomen, and the chest.

##### **(III) Difference made by forward/backward seat**

If the seat is heavily inclined forwards, it puts a burden on the casters, which may in turn increase the running resistance and deteriorate the rotating ability. Also, it causes the trunk to fall forward which does not allow moving the upper limbs powerfully, and with sudden application of the brakes the pelvis slides forwards making it easy to collapse. Making it more inclined towards the back improves the rotating ability and provides a more stable trunk balance but the front wheels are likely to lift up when the player rows the wheelchair. It also makes it easy to fall over backwards. Therefore, the backward inclination of the seat must be determined after thoroughly confirming its relation with the axle.

##### **(IV) Seat (depth and width)**

If the depth of the seat is too much, the popliteal fossa (area behind the knee) and the lower leg part will hit against the seat as the legs shift their position during movement of the wheelchair, which may lead to bedsores. If it is too less, the hold of the legs will not be strong enough, giving lower trunk stability. As for the width of the seat, a narrow seat will provide a better hold and a stable trunk but the area around the greater trochanter will get struck, leading to bedsores. If it is too wide, the stability of the trunk will be affected.

## 2) Practice

### (1) Stretching the shoulder joint area and muscle strength training

Many persons with cervical cord injuries suffer from chronic fatigue in their necks and upper limbs due to overuse of the upper limbs from everyday activities like transferring from wheelchair to bed, toilet or bathtub, changing clothes, and bathing in addition to continuously using their upper limbs for moving the wheelchair. Additionally, wheelchair sports athletes suffer more sports injuries in the upper limbs and shoulder joints compared to the lower limbs. The shoulder joint is an important part of the motor function of the upper limbs and injury to the shoulder joint does not only hinder sports activities, but also greatly hinders the ADL. There are four small muscles in the shoulder joint that connect the shoulder with the upper arm; the supraspinatus, infraspinatus, teres minor, and subscapularis. This group of muscles is known as the rotator cuff. They act as stabilizers for the shoulder joint and since they lie very deep in the body, they are also known as the inner muscles. While on the other hand, the large group of muscles in the outer layers of the shoulder covering the rotator cuff consisting of the deltoid muscle, trapezius muscle, latissimus dorsi muscle, and pectoralis major muscle are called the outer muscles. A well-balanced training of the inner and the outer muscles combined is known to be significantly effective in preventing shoulder joint injuries. Therefore, in the following section we introduce stretching and exercise for the shoulder blade and area surrounding the shoulder joint as a part of strength training and prevention of sports injuries.

#### (I) Stretching

- Neck: prevertebral muscle group, sternocleidomastoid muscle, etc.  
Front and back, left and right, rotations
- Shoulder: deltoid muscle, trapezius muscle, latissimus dorsi muscle, and pectoralis major muscle  
Back, sideways to front, rotations
- Arm: anterior deltoid, serratus anterior muscle  
Outward rotation of the shoulder girdle
- Trunk: trapezius muscle, latissimus dorsi muscle, rectus abdominis muscle, and abdominal oblique muscle  
Lateral bending, twisting
- Wrist: forearm muscle group  
Dorsal flexion, palmar flexion

#### (II) Exercise of the shoulder blade and area surrounding the shoulder joint

- Bringing the elbow to the shoulder level, bend the elbow joint horizontally at 90 degrees and move it backwards and forwards.
- Bringing the elbow to the shoulder level, bend the elbow joint vertically at 90 degrees and move it up and down.
- Bringing the elbow to the shoulder level, bend the elbow joint vertically at 90 degrees and

move it left and right.

- Bringing the elbow to the shoulder level, extend the elbow joint and rotate the whole arm from the shoulder in circular motions. One time forward and one time backwards.
- Bringing the elbow to the shoulder level, extend the elbow joint and move it up and down.
- Bend the elbow joint at 90 degrees and move the arm left to right.

## **(2) Running**

### **(I) Boarding posture**

Observe the boarding posture in resting state to make sure that the pelvis is horizontal. Riding in an incorrect posture for long durations distorts the pelvic position, making the trunk curve into an S shape with the neck tilted. Extreme forward or backward inclination, and lateral curvature need to be corrected as it may impact the performance while also causing sports injury or bedsores. The sitting position is considered to be correct when the Jacoby lines on both sides of the anterior superior iliac spine are parallel to the floor.

### **(II) Handling**

Handling of the handrim tires may differ according to the residual functions. The low pointers do not have any elbow extension function and therefore handle the handrim with the back of the hand and drive the wheelchair using dorsal flexion of the wrist joint and forearm supination. Since the high pointers have the finger grip function, driving while handling the ball with the palms is the most effective method for using the strength of the upper limbs and the shoulder girdle.

### **(III) Driving form**

Leaning forward when starting to push through prevents the casters from rising up due to time loss. For handling, place the hands slightly behind the trunk, gradually push downward and forward will force until you achieve the rowing stroke. Then, prepare for rowing again. Momentarily relaxing between the strokes makes it possible to drive the wheelchair for a long duration.

## **(3) Dribbling**

### **(I) Low pointers**

Low pointers can use both hands for dribbling. Incline forwards while holding the ball in both hands, extend both the hands as much as possible and drop the ball. Catch the bouncing ball. Low pointers get much fewer opportunities to dribble compared to the high pointers as they do not get many opportunities to hold the ball.

### **(II) High pointers**

High pointers can dribble and throw-and-dribble with one hand. The ball can be dribbled using two methods; dribbling by bouncing the ball, and dribbling by first throwing the ball in front or on the side to make it bounce. Throw dribbling gives more speed as the player can row the wheelchair many times while the ball is not in their hands. The height, distance and angle at which

the ball is thrown are regulated by the speed of the wheelchair.

#### **(4) Passing**

##### **(I) Low pointers**

For a forward pass, they can hold the ball by the back of the hand by pronating both the forearms. Projecting both the elbows outwards, use the forearms to pull the ball towards the trunk, push it up so as to roll it up while keeping the forearms supine, and pass the ball ahead.

##### **(II) High pointers**

Can do a chest pass by extension of the elbow joint and palmar flexion of the wrist.

#### **(5) Picking up**

##### **(I) Common for low and high pointers**

For picking up the ball from the floor, pin down the ball to the tire close to the floor using rotation of the wheel, place it between the tire and the handrim and scoop up the ball raised from behind the wheel on to the knee. At this time, lock the elbow joint that is supporting the ball, making sure to never bend the elbow. Pulling up the ball in a hurry will make you lose the point of contact between the ball and the hand and frequent fumbling.

#### **(6) Tackle**

In wheelchair rugby, tackling is permitted from all directions. It is particularly important for beginners to practice tackling before the game formation. Given below is an introduction to front tackle in step-up order.

##### **(I) While you are at standstill, the opponent moves forward and tackles you from the front.**

To prepare for this, tilt backwards before the contact. Once you are accustomed to this, ask the opponent to increase their speed.

##### **(II) While your opponent is at standstill, you move forward and tackle the opponent from the front.**

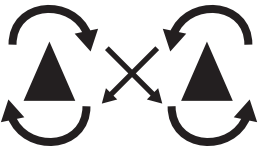



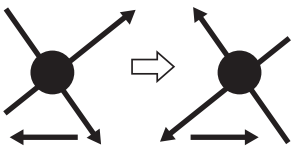






To prepare for this, tilt backwards before the contact. Once you are accustomed to this, increase your speed.

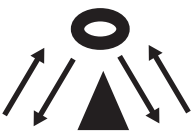




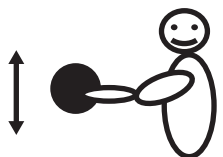





##### **(III) You and the opponent both move forward to tackle each other from the front.**

To prepare for this, tilt backwards before the contact. Once you are accustomed to this, both you and your opponent can increase the speed.



**(7) Practice drill (example)**

Name	Figure	Details
I. Figure-of-eight		<ul style="list-style-type: none"> <li>• Make a figure-of-eight around cones that are 2 meters apart</li> </ul>
II. 2 m agility		<ul style="list-style-type: none"> <li>• Move backwards away from the cone once</li> <li>• Turn 270 degrees from outside the  part and move towards the cone on the opposite side</li> <li>• Once again, move backwards away from the cone</li> </ul>
III. Tube I (External rotation of shoulder joint)		<ul style="list-style-type: none"> <li>• Repeat shoulder joint external rotations while the elbow joint is bent at 90 degrees</li> <li>• Switch between left and right in 30 seconds</li> </ul>
IV. Ball I (Wheel up)		<ul style="list-style-type: none"> <li>• Holding the medicine ball with both hands, move in the order of the arrows in the picture</li> <li>• Perform same movements on reverse side indicated by </li> </ul>
V. Shoulder joint horizontal extension movement	 ." data-bbox="388 621 574 691"/>	<ul style="list-style-type: none"> <li>• Bring both the shoulder joints near each other in direction of the </li> <li>• Change the palms from top to bottom in 30 seconds</li> </ul>
VI. Two pushes / 1 back		<ul style="list-style-type: none"> <li>•  2 pushes forwards</li> <li>•  1 back backwards</li> </ul>

Name	Figure	Details
VII. Turn agility		<ul style="list-style-type: none"> <li>•  Move forward</li> <li>•  Move backward</li> <li>•  Turn around</li> </ul>
VIII. Tube II (Shoulder joint abduction + horizontal extension movements)		<ul style="list-style-type: none"> <li>• Pull the tube from the abdominal region diagonally in upward backward direction</li> <li>• Change between left and right in 30 seconds</li> </ul>
IX. Ball II (Feint shaker)		<ul style="list-style-type: none"> <li>• Holding the medicine ball  with both hands, begin shaking it in the arrow directions (up and down)</li> <li>• Players with trunk function can move it left to right also</li> </ul>
X. One push / one back agility		<ul style="list-style-type: none"> <li>•  Move forward</li> <li>•  Move backward</li> </ul>
XI. Air / rowing		<ul style="list-style-type: none"> <li>• Perform rowing action without actually rowing the wheelchair</li> <li>• Perform big and fast actions</li> </ul>

### 3) Measurement of physical strength

It is imperative to have the basic knowledge on "physical strength and athletic ability" of persons with disabilities not just for promoting their health preservation but also for nurturing and strengthening athletes for the Paralympic games. The results of measuring the physical strength as body resources and athletic ability which can be considered as task performance in everyday life are more meaningful to persons with disabilities compared to persons without disabilities as they are considered as information for verifying the effectiveness of training and are useful for more effective modification of the programs. Similarly, it is extremely important to measure the physical strength and athletic ability of wheelchair rugby athletes as well, and use the results for training them in order to further improve their physical strength, athletic ability as well as competitive ability. It is essential to test the physical strength in order to know the physical strength of the player well. Sports centers for persons with disabilities usually provide such measurements. Given below is an introduction on practical application of the physical strength and athletic ability results on the actual spot.

### **(1) Structure**

For measuring the height, the player is made to lie in a supine position as aligned to the floor as possible and the length from the top of the head up to the base of the heel is measured alongside the floor surface. Weight is measured by making the person get on a weighing scale while seated on a regular wheelchair, and then weight of the person is obtained by deducting the weight of the regular wheelchair and the clothes. For chest measurements, the person is seated in a natural state in the wheelchair with the shoulders and arms relaxed and both arms lowered naturally at the time of measurement and chest is measured horizontal to the trunk at the peak of the nipples. Measurement is taken during normal breathing between an exhalation and the subsequent inhalation.

### **(2) Respiratory function test**

This test measures the lung capacity. Measurement is done using an electronic diagnostic-use spirometer. Sit naturally in the wheelchair, put on the nasal plug, put the mouthpiece on the mouth and start quiet breathing as instructed by the test operator. Next, exhale completely to the last breath and then take a deep full breath, and finally exhale completely to the last breath.

### **(3) Muscular strength**

The strength of the shoulders (pressed) is measured. A dynamometer is used for the measurement. Sit naturally in the wheelchair and rotate both the shoulder joints outwards at 90 degrees. Grasp (press down) the left and right bars of the dynamometer from the respective sides using your hands while simultaneously pushing with all your strength and bending horizontally (applying pressure).

### **(4) Instantaneous force**

Measured using a 20 meter race. The subject is instructed to stay still with the front wheels of the wheelchair behind the start line so that the wheels are not touching the start line. The subject then has to drive the wheelchair with full strength upon getting the start signal. Using a stopwatch, the travel time is recorded in 0.1 second units until the center of the front wheels of the wheelchair is on the goal line.

### **(5) Endurance**

Measured using a 3-minute race. At the measurement facility, a course is set by placing 2 cones (height 0.3 m) at a distance of 20 m from each other. The subject is instructed to be positioned behind the start line at the beginning of the course so that the front wheels of the wheelchair are not touching the start line. The subject has to run the wheelchair to the longest distance possible in 3 minutes upon getting the start signal. Also, while turning back from the installed cone, the subject has to turn the cone outwards. The travel distance is calculated by adding the distance from the start line up to the center of the wheelchair front wheels at the end of 3 minutes measured using with a measuring tape, to the distance calculated from number of times the subject made a round trip

around the course. The travel distance is measured in 0.1 m units and the records are rounded off to the decimal point in meter (m).

#### **(6) Agility**

Measured using repeat turns. At the measurement facility, three parallel lines are made on the floor at a distance of 1.2 m using line tape. The subject straddles the middle line with the left and right large wheels on either side of the line and waits for the signal. After getting the start signal, the subject turns 90 degree to the right (left) and moves forward, and once both the front wheels of the wheelchair cross or touch the line, turns backwards and turns towards the center line. At this time, the wheelchair should be straddling the middle line with the left and right large wheels in the same direction as starting position. Next, the subject turns 90 degree to the left (right) and moves straight ahead and once both the front wheels of the wheelchair cross or touch the line, turns backwards. This action is repeated for 30 seconds, and each time the line is passed is considered as 1 round, and the total number of rounds is recorded.

#### **(7) Motor skills and instantaneous force**

Measured based on ball play. The subject is positioned with the front wheels (casters) of the wheelchair on the line, from where the subject throws the ball without stepping on or crossing the line during or after the pitching, and the distance up the point where the ball drops is measured.

### **4) Focal points about coaching**

Persons with disabilities may experience many new movements for the first time after taking up sports. One of the first experiences of persons with disabilities is the fear of tumbling over or falling from the wheelchair. If the coach completely understands and acknowledges this sense of fear present in persons with disabilities, it makes the person more secure about engaging in sports. While showing empathy, the coaches must also try to relieve the sense of fear to as much extent as possible. After having impairment, even people who were positive earlier tend to fall in a negative state of mind and become passive. Rather than trying to make them do things that are unachievable, the coaches must try to devise as many successful experiences as possible. They should be given step-by-step guidance that is individually tailored to suit their situation.

Getting too addicted to sports can easily lead to getting injured or overworked. Particularly the beginners are very likely to fall into this state. While it is very important to experience falls and feel overworked, it can also create a negative picture about continuing with the sport later depending on the level of hurt it caused. It is important to ascertain the level of physical strength and skill of the target person.

## **Conclusion**

With the implementation of the Basic Act on Sports (2011) and decision of holding the 2020 Paralympics in Tokyo, the environment involving sports for persons with disabilities in Japan has been undergoing a major transitional phase. The Basic Act on Sports states that "sports must be promoted while giving the necessary consideration to the type and degree of disability so as to enable persons with disabilities in independently and actively pursuing sports." and that "Sports must be efficiently promoted while striving to organically link the various policies that contribute to the improvement of the level of competition in sports so as to enable the Japanese athletes to achieve excellent results at international competitions (Olympic events, Paralympic events, and other international-level athletic meets), or at national-level sports meets." as the fundamental principles for the promotion of sports for persons with disabilities. In addition, the "Convention on the Rights of Persons with Disabilities" ratified in 2014 in Japan clearly specifies 5 specific actions to be taken under the statement "With a view to enabling persons with disabilities to participate on an equal basis with others in recreational, leisure and sporting activities, States Parties shall take appropriate measures" mentioned in Article 30 "Participation in cultural life, recreation, leisure and sport". The governance of sports for persons with disabilities that was under the jurisdiction of the Ministry of Health, Labour and Welfare until April 2014 was transferred to the Japan Sports Agency under the Ministry of Education, Culture, Sports, Science and Technology in October 2015. In this way, the environment involving sports for persons with disabilities in Japan has been undergoing a major transition.

In this manual we gave an introduction on sports for persons with severe cervical cord injury. It is imperative to have the basic knowledge on sports for persons with cervical cord injury, not just for promoting their health preservation but also for nurturing and strengthening athletes for the Paralympic games. However, in present day Japan, this type of fundamental expertise is not widely available and there is a scarcity of systematic and continuous knowledge. We would greatly appreciate if this manual is referred to by sports instructors as well as most of the staff involved in rehabilitation not just for persons with cervical cord injury but is also used as a means of introducing sports for people undergoing rehabilitation and for other wheelchair sports.

## **Rule and Classification of Wheelchair Rugby -International Wheelchair Rugby Federation-**

Rule: [http://www.iwrf.com/?page=rules\\_and\\_documents](http://www.iwrf.com/?page=rules_and_documents)

Classification: <https://www.iwrf.com/?page=classification>

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