The Para-backhand Pushing Technique

Increasingly rigorous training in wheelchair racing has been associated with a rise in the frequency of impact injuries to the hands and a variety of stress-related injuries to the wrists, fingers, thumbs, and elbows. This observation prompted the University of Illinois (U of I) wheelchair-sports staff to initiate field-based studies on how the propulsion mechanics of racing could be altered to reduce injuries without undermining performance. As a result, the para-backhand technique and the design for a radically different, specialized racing glove (Harness Designs) were born.

The para-backhand technique is characterized by contact along the distal surface of the fingers [fingertips] with base support provided by the thumb. This differs from conventional-stroke mechanics, where contact occurs at the index and middle fingers and the base of the thumb.

The design of the specialized glove accommodates these altered stroke mechanics. Materials used in fabrication provide greater adhesion, stability, and protection for contact points on the hands than do conventional handball gloves wrapped in tape or elastoplast. Over the last three years, this technique has been adopted by the U of I wheelchair track team. Frequency of injuries has diminished while the athletes' performances have improved.

In this article we will give some tips on how to prevent injuries. We will also explain the detailed mechanics of the para-backhand stroke technique.

INJURY PREVENTION

• *Minimize impact injuries to hand joints*
The possibility of stress fractures is always present in sports involving significant impact. In wheelchair racing, trauma often results from the repeated, forceful impact that occurs between the points of contact on the hands and the push rims. In the conventional style of pushing, this happens at the base of the index finger, which is driven with substantial force into the push rim along a diagonal trajectory. The backhand stroke allows athletes to strike the push rims more smoothly and with less force impact while distributing this impact over a greater area of the hands.

Figure I

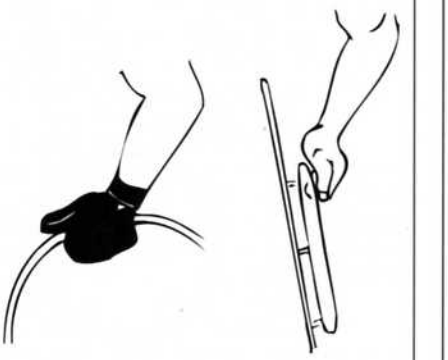
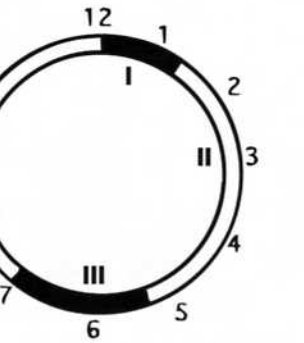


Figure I-A



ILLUSTRATIONS BY TONY INIGUEZ

The para-backhand stroke has five basic phases: the catch, drive, release, lift-and-stretch, and acceleration. In the catch phase (Figure I), the stroke begins with the hand in the "hitchhiker's pose," and the wrist is flexed to the thumb side (radial deviation). View the push rim as a clock face (as depicted in Figure I-A). Contact with the push rim is made at the points between 1:00 and 1:30.

Figure II

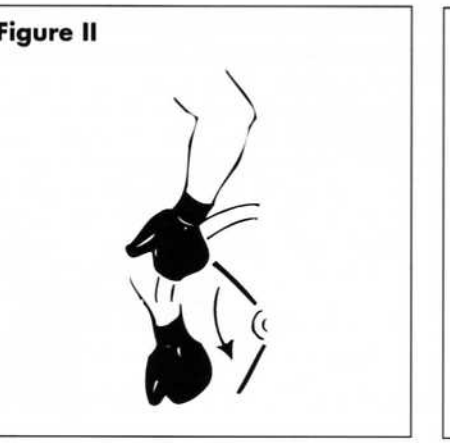
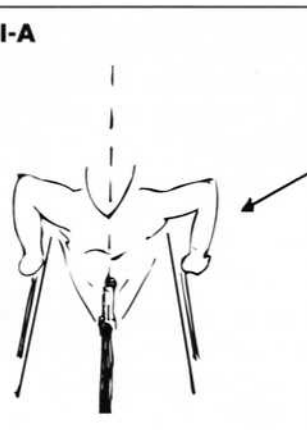


Figure II-A



Initial contact with the push rim is made with the fingers rather than the thumb. This occurs between the back of the middle and index fingers (Figure I). It is important to press the thumb into the index finger to ensure optimal hand stability during initial contact. Because hands are locked in the closed position with hook-and-loop fasteners, the contact surface accommodates a solid, controlled application of force. The initial contact point on the push rims will vary as stroke velocity increases. For example, at speeds under 12 miles per hour, contact will occur between 1:00 and 1:30. As speed increases, the contact point will occur progressively later.

In the drive phase, the last joint of the thumb rides forward around the outside of the push rim while the base is squeezed against the tip of the index finger (Figure II). The arms are forcefully squeezed into the push rims using the arm and chest muscles to adduct [move toward the center line of the body] (Figure II-A). This will disperse the force through the back of the middle and index fingers. Hands ride around the outside of the push rim. The contact point switches from this location to the base of the thumb and index- and middle-finger cuticles at 5:00 to 7:00.

This contact is further improved if Harness Designs gloves are used, because of the consistency of their cushioning. They are generally better at retaining their shape and resisting the redistribution/compression of the padding. These cushioning problems cause "low spots," which can lead to injuries. When baseball or handball gloves are used, the padding must be checked and tape applied daily.

Figure III

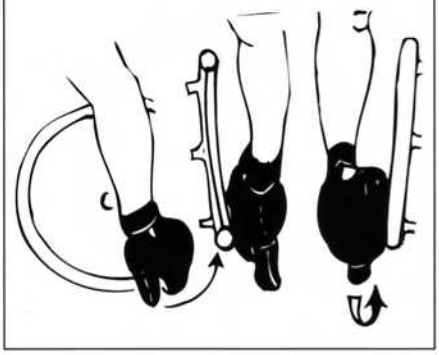
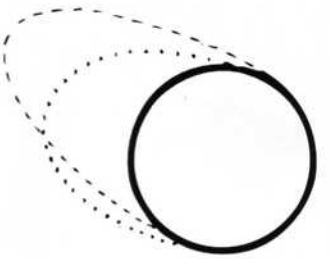


Figure II-B



In the release phase (Figure III), the thumbs ride in front and around the push rims, and the hands are flexed to the little-finger side of the wrist (ulna deviation). This movement is similar to a hammering motion or driving a thumb tack.

It is important that the hands do not rotate away from the push rim upon release. This type of movement could cause elbow tendonitis or associated forearm or elbow problems. The stroke ends with the tips of the fingers riding around the bottom of the push rims (Figure II-B). The release location will vary according to speed. The lower the speed, the earlier the hands begins to release.

Figure IV

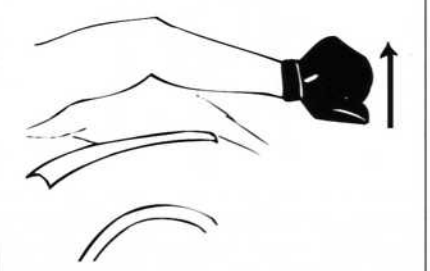
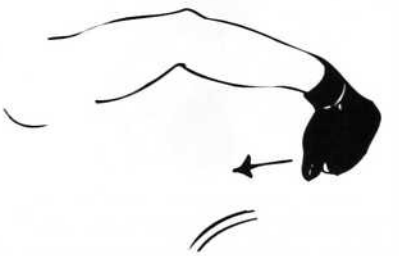


Figure V



The elbows are forcefully lifted up and behind (shoulder extension) in the lift-and-stretch phase (Figure IV). It is essential that the upper- and middle-back muscles are sufficiently strengthened to produce optimal lift. The large pectoral chest-muscles should be flexible and supple to facilitate optimal stretch and range of motion.

With the shoulders extended, a stretch reflex in the chest and anterior shoulder muscles is induced when the shoulder is bent. At the same time the acceleration phase begins (Figure V). In this stroke, the arms gain in velocity to enhance the force of the catch and drive phases.

An impact injury to the metacarpal phalanx joint (bottom knuckle) of the index finger is another problem with conventional-stroke mechanics. This joint is the principal contact point, so it must absorb the greatest force. Because the knuckle was not designed for this kind of punishment, soft-tissue damage often results. The backhand stroke eliminates the direct punching of the push rim, allowing the hands to apply force by moving more smoothly.

- *Reduce stress to wrists, fingers, thumbs, and elbows*

Other stresses associated with the use of conventional-stroke mechanics include soft-tissue injuries to the tendons of the wrist, thumb, and fingers;

Figure VI

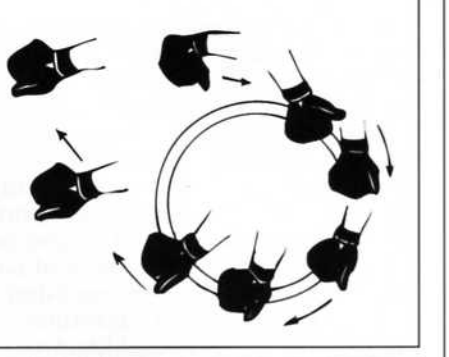
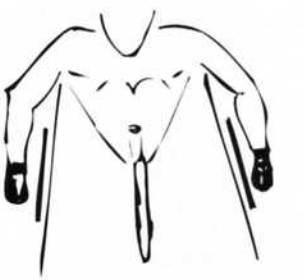


Figure VI-A



Figures VI and VI-A depict the complete pushing cycle and arm alignment with the rear wheels.

chip fractures and bruising of the thumb; and forearm injuries caused by excessive pronation/supination [rotation]. Tendons that connect muscles to bones are susceptible to injury. They may be injured by direct contact—repeatedly striking them against hard surfaces such as push rims.

Indirect damage to tendons most commonly occurs to the wrist, fingers, or thumb. Stretching them during contact with push rims may cause injury in these cases. The thumb is pulled back into abduction (away from the index finger), the wrist is forced backwards, and the tendons to the backside of the fingers are stretched over the knuckles. Risk of injury can increase if gloves are not taped properly.

Because the thumb is the major mover during the stroke, it also becomes the focus of injury. The abduction and extension stress to the knuckle may push it past its anatomical limits if not properly protected by

the glove and tape. If this occurs, there is a risk of chip fractures or bruising.

Another detrimental aspect of the conventional stroke is excessive pronation and supination of the forearms at the end of the stroke. (This movement is roughly equivalent to turning a doorknob.) Used to "flick" the thumb off the push rim, repeated inward rotation at the bottom of the stroke can lead to irritation of the elbow's muscle/tendon group (often referred to as "tennis elbow"). In the para-backhand stroke, athletes maintain a neutral position throughout the stroke, and the rotational force to the forearm and elbow is reduced.

- *Under-glove protection from soft-tissue injury*

Blisters and skin irritation are common to wheelchair athletes and runners. The problem for both is frictional irritation. Runners can wear the right type or numbers of socks; wheelchair athletes have similar options. With the new type of prefabricated gloves, an inner lining may be used. By reducing friction and dispersing sweat, these liners help prevent blisters.

MISTAKES TO AVOID

In attempting to adopt the para-backhand technique, athletes must avoid the following errors, which could result in an appreciable loss of stroke efficiency.

In the catch phase:

- *Using the thumb instead of the back of the fingers*

Gloves were not designed for this type of movement, which offers little protection for the side of the index finger. This could result in soft-tissue injuries and excess stress on the bones of the fingers.

- *Pushing with the back of the hands on the top rather than the outside of the push rims*

This type of stroke movement will result in premature release from the push rims, because the hands can't rotate over the top and ride around the bottom of the stroke. It is essential that the catch phase be initiated on the *side* of the push rims.

- *Pushing with rigid wrists*

This type of movement will also result in premature release from the push rims. Potential contact is reduced, because rigid hands do not allow for accommodation of optimal contact between the glove and push rim.

- *Failure to keep hands closed*

This will result in inconsistent hand contact and inflammation of forearm flexors and extensors. When hands are secured with hook-and-loop straps, they will remain closed, and contact will be consistent. This could result in cramping. A small piece (3"–4") of plastic or vinyl tubing can be placed in the hands to alleviate spasms. The hand brake should be within easy striking distance, and open hands should not be required to operate it. At the U of I, we have mounted brakes with the lever facing vertically. The only action we have to perform is applying pressure in a downward punching motion.

In the drive phase:

- *Making contact too deep inside the push rims*
- *Riding the gloves too low toward the heel of the hands*
- *Rotating hands on top of the push rims*

This error causes an early release.

In the release phase:

- *Lateral rotation of the hands at release*

This type of movement will result in premature release from the push rim and greatly reduce the potential contact area.

- *Getting hands caught inside the push rims*

Thumbs must be forcefully driven toward the rear of the wheels.

In the lift-and-stretch phase:

- *Failure to lift with upper-back muscles*

In the acceleration phase:

- *Tightness in pectoral muscles*

This inhibits a full range of motion at shoulder joints. As a result, full stretch and acceleration are not achieved.

CONCLUSION

The para-backhand is substantially different from conventional stroke mechanics. Therefore, it takes considerable time to become proficient with the technique. For further information concerning the para-backhand, contact the University of Illinois Office of Recreation and Athletics, 1207 South Oak Street, Champaign, IL 61820. (217) 333-4606.

The above article was written by Marty Morse, Tim Millikan, and Brad Hedrick.

Reprinted from **Sports 'n Spokes,** May/June 1994.
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