Anatomy of the Sports Wheelchair

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The Panoply of Wheelchairs used in elite disability sport today evolved from the conventional chrome folding-style wheelchair we have all seen in hospitals and other medical environments. It was a “one size fits all” medical approach to physical activity for individuals with disabilities. During the mid-1970s, however, there was a move to a functional perspective of physical activity for persons with disabilities through legislation, a more functional classification system, and a revolution in wheelchair design led primarily by the athletes themselves.¹

This functional perspective was reflected in the development of the “box frame” for wheelchair basketball.²⁻⁴ It was basically an aluminum box with wheels attached that eliminated the folding mechanisms associated with the traditional wheelchair. This concept resulted in lighter and more rigid chairs and, more important, it allowed wheelchairs to be designed for a specific purpose. No longer a multipurpose wheelchair intended for all activities, the new wheelchairs target the performance requirements of the specific activity and maximize the functional capacity of the athlete who has a disability. This article gives an overview of the components, styles, and materials used in sports wheelchair design.

The Court Chair

This chair is used for court sports such as wheelchair basketball and wheelchair rugby, and also for general activity such as physical education classes or recreational pursuits (Figures 1 and 2). The drive wheels, the two larger wheels, are generally at the back of the chair, although in some cases they may be located at the front. Affixed to the drive wheels are the push rims. On the court chair these are almost the same size as the drive wheels and are used to apply force to move the chair.

Figure 1 The court chair (used with permission of Per4Max Medical).

Figure 2 Schematic of the court chair.
At the center of the drive wheels is the hub, which includes not only the bearings that allow the wheels to rotate but also a quick release mechanism that locks the drive wheel in place and allows for easy removal of the wheel so the chair can be transported. These chairs generally do not collapse, and removal of the drive wheels is the best storage or transportation method. At the front are two casters that rotate to allow for maneuverability. They come in a variety of sizes. When the chair is to be used indoors, these casters can be as small as skateboard wheels (see Figure 1). If the chair is to be used outdoors, these wheels need to be larger (up to 8 in.) to allow for uneven terrain.

The final element is the main frame in which the athlete sits. The relationship of the main frame to the drive wheels is critical to the performance of the chair. If the frame is set low and to the back of the central hub, the chair will be maneuverable but difficult to keep stable (Figure 2, main frame A). This can be somewhat minimized by the installation of a small fifth wheel behind and below the main frame. If the frame is set high and forward of the hub, the chair will be less maneuverable but more stable (Figure 2, main frame B).

A subset of the court chair is the tennis chair. While many elite tennis players use a variation of the standard court chair, others prefer one that is a hybrid of both court- and racing-chair technologies. As seen in Figure 3, the tennis chair differs from the court chair in that it has only a single front caster and a slightly longer main frame. The single front caster reduces friction by reducing the number of wheels from four to three. The slightly longer main frame increases the stability of the chair, which has been compromised by having only one front caster.

The Racing Chair

The racing chair is a radical departure from what most people perceive as a wheelchair (Figure 4). It is a basic T-frame that provides not only rigidity but, given its elongated front, also stability. Rigidity and stability are essential at the high speeds achieved by marathon racers. Indeed, the top men’s wheelchair racer in the 2003 Boston Marathon, Ernst Van Dyk of South Africa, completed the 26-mile course in 1 hr 28 min. The fastest runner without a disability was Robert Cheruiyot of Kenya, who finished in 2 hrs 10 min.

With racing chairs the single front caster is not used for maneuverability so much as for stability. The much larger diameter front caster for negotiating uneven terrain is fixed to the main frame via a steering mechanism that allows the athlete to make gross turning adjustments and helps the chair track against the camber of a road or turn around a track. The push rim on a racing chair has a much smaller diameter than on a court chair. This acts as a gearing mechanism so that a relatively small movement of the push rim translates to a large movement of the drive wheel. Unlike actual gearing, this is permissible in competition. The athlete sits in a tucked position in the bucket seat with the heels secured directly below the T-frame. This centers his or her weight over the drive wheels and reduces rolling resistance on the front caster. Since rigidity is such a priority, many athletes prefer to bolt the hub of the drive wheel to the T-frame rather than using a quick-release mechanism.

Wheelchairs Without Wheels

The ultimate expression of functionality in sports chairs are the wheelchairs without wheels. In this group the functional needs of the activity are such that wheels do not actually help in the task. An early example of this was the throwing chair used in track & field competition. In throwing events such as discus and javelin, there is no advantage to a chair that moves. Rather, the athlete needs to throw from a