

GROUNDWORK



by Cheryl D. Fields, *TeamRehab Report*

CASTERS

Easy to overlook because of their size, casters are critical to the performance of a wheelchair. Here are a few clues on how to evaluate them and match your clients' needs.

Most supermarket shoppers have learned to distinguish between user-friendly and hostile shopping carts. There is nothing more irritating than trying to navigate narrow market aisles with a cart that has shimmying, bumping wheels that pull left when you want to turn right.

The irritation is even greater if the casters on your wheelchair are just as unwieldy. Therefore, therapists must be discriminating when it comes to choosing casters for their clients.

Casters are the small wheels that provide frontal support for a wheelchair base. They range in size from 2.75-8.25 inches and come in solid, wire and molded wheel styles with pneumatic and non-pneumatic tires.

Fortunately, the level of craftsmanship devoted to making wheelchair casters is better than that of most shopping cart wheels. But if fit improperly, some of the same problems experienced at the market could occur to a wheelchair rider.

Caster Shimmy

Shimmy is the self-excited fluttering from side to side that usually occurs when casters move at accelerated speeds. In extreme cases, a shimmying caster can cause a wheelchair to turn suddenly and throw the user out of the chair. Shimmy should not occur at normal riding speeds, but there are several reasons why it might.

If caster shimmy occurs at normal riding speeds, the rehab team should:

- examine the position of the caster fork and stem;
- check the shape of the wheel, and
- check for sufficient tension in the caster axle and swivel stem.

The caster fork stem should be in a vertical position, perpendicular to the floor (Figure 1). Adjusting the position of a non-vertical fork stem should help reduce shimmy.

Any time wheelchair adjustments are made—such as changes in the wheelbase height or pitch, rear wheel or tire size, and some foot plate adjustments—the rehab team should make sure the position of the caster fork stems has not been disturbed. If so, they should be returned to a vertical position. In addition, damaged or bent

wheelchair forks should be repaired prior to use.

The trueness of casters, as with larger wheels, relates to its shape. If a wheel is warped or disfigured, it should be repaired or returned to the manufacturer. An untrue caster will excite shimmy and present other hazards.

When examining the caster stem, the rehab team also should observe some tension in the swivel axis and at the wheel axle.

Maintaining tension at the swivel axis and at the caster's spinning axis can reduce castershimmy. The tension effectively inhibits unnecessary movement of the casters, without creating too much pushing resistance for the rider.

The Impact of Size

Another way to minimize shimmy is to reduce the size and weight of the casters and to increase the trail.

"Heavier caster wheels will go into shimmy faster than lighter ones," says James J. Kauz-

larich, Ph.D., University of Virginia Rehabilitation Engineering Center, Charlottesville.

Trail is the distance between the point on the ground directly beneath the caster fork stem and the point at which the caster tire meets the ground (Figure 2). The longer the trail, the faster one can travel before experiencing shimmy, Kauzlarich says.

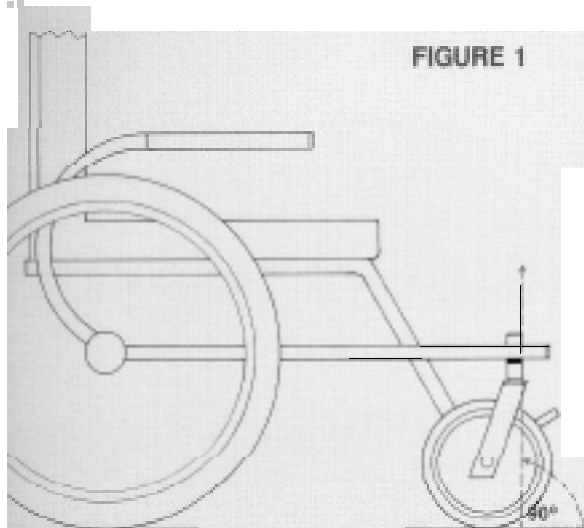
Large caster wheels typically have a shorter trail than small ones. Subsequently, large wheels begin to shimmy at lower speeds. Many athletes choose small casters because they are lightweight, making them less apt to shimmy even at high speeds. A small wheel with a long caster fork will also have a longer trail, further discouraging shimmy. But extending the trail can reintroduce the problem of having the casters catch onto the rider's heels while turning.

Some manufacturers offer a longer caster stem so that small-wheel users can still use a short fork. The short fork reduces the likelihood of the caster catching onto the rider's feet, but also shortens the trail.

Even with this shorter trail, the ride has less shimmy than that found when using a larger wheel with a trail of equal length.

Despite their advantages, small casters are not the best choice for everyone. "You wouldn't put a first-time wheelchair user in a chair with 3-inch

FIGURE 1



"The manufacturers aren't going to tell you the speed at which the casters will begin to shimmy. The only way you can find this out is to try it yourself."

— JJ Kauzlarich

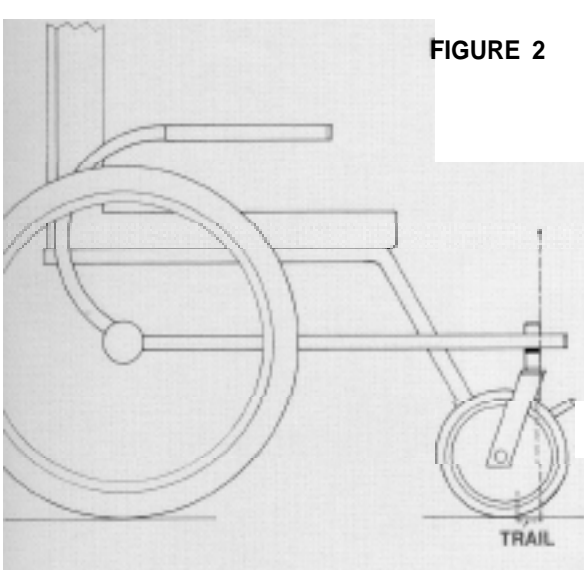
casters," says Marty Ball of Medical Composite Technology, Santa Cruz, Calif. Using small casters requires more riding skill, he says.

Small wheels don't go over bumps easily. Since they can become lodged in breaks in the rolling surface, riding with small casters on unpaved surfaces, in and out of elevators, or passing over street grates can be problematic for inexperienced riders. Skilled riders can negotiate these obstacles by riding over them using the rear wheels only. But this technique requires upper-body strength, balance and experience — characteristics most new riders lack.

"A lot of therapists prescribe large front casters because they roll easier over grass and gravel," Ball says. "But when you rotate and swivel, they can hit you in the feet. Tiny tires perform better in turning. You minimize the resistance, they're lighter in weight, and they won't hit anything."

Knowing the rider's ability and what types of surfaces the chair is most likely to roll over will help the rehab team select the appropriate casters.

FIGURE 2



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Many experts encourage rehab teams to test the casters in the client's home and work environment.

"If you're going to use it outside you've got to try the chair outside and see what happens." Kauzlarich says. "The manufacturers aren't going to tell you the speed at which the casters will begin to shimmy. The only way you can find this out is to try it yourself."

Generally, wheelchair casters range in price from \$35 to \$100 a pair, although manufacturers usually include them with the price of the chair.

Casters come in both pneumatic and airless models. As with rear wheels, maintaining the suggested pressure in a pneumatic caster will provide a smoother ride and help avoid shimmy.

"Maintaining the right tire pressure in pneumatic casters is even more important [than in rear tires]." says Rein Stolz, vice president of engineering at Skyway, Redding, Calif. Because caster tires are so small, they are easy to overinflate.

There is a knack to getting the pressure gauge out without letting too much air escape, Stolz says. "You usually have to inflate it a few pounds higher because you know you're going to lose

pressure while trying to remove the gauge."

Most pneumatic casters offer a smoother ride than do the airless, but the popularity of pneumatic casters has decreased over the years, as more consumers demand low- to no-maintenance wheelchair components.

Many athletes choose small casters because they are less apt to shimmy even at high speeds.

When it comes to selecting wheelchair casters, there are no easy answers. You usually weigh the pros and cons, and then compromise to get the best combination of size, strength, maneuverability, performance and shock absorption, Kauzlarich says. †

References: "Wheelchair Mobility -Analysis and Design of Structural Components and Systems: Task 11 Caster Shimmy," by James I Kauzlarich, Ph.D., John G. Thacker, Ph.D., and E.V. Mochel, MS., 1983-1988, University of Virginia Rehabilitation Engineering Center; and "Wheelchair Caster Shimmy and Turning Resistance," by Kauzlarich, Ted Bruning, and Thacker, 1984, Veterans Administration Journal of Rehabilitation Research and Development, Vol. 20, No. 2, BPR IO-40, pp. 15-29.

The first and second parts of "Groundwork," covering tires and wheels, appeared in the November/December and January/February issues.