We Think It's Safe, But Should Seesaws Perform More Consistently?

By I. Martin Levy, MD, Joseph M. Mansour PhD, Peter A. Torzilli, PhD, Clare M. Rimnac PhD, Evan Heiser and John Pysarchuk

The seesaw obstacle, which has been included in dog agility since the sport's beginning, has recently been facing scrutiny. It is the only moving obstacle, and therefore, the performance of the obstacle itself can influence the dog's performance on course. With the increasing speeds of the canine participants, the functional consistency of the seesaw and the overall safety of this obstacle is now being questioned. Furthermore, it has been suggested that the normal action of the seesaw may increase the risk of injury from impact overload and repetitive force application. Because of these concerns, some have suggested that the seesaw be removed from competition.

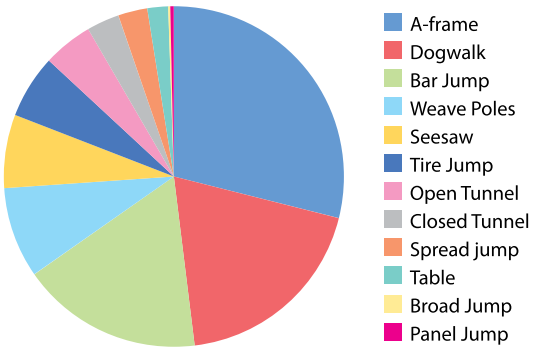
Removal of the seesaw obstacle from competition is unwarranted. Our study of injuries to dogs participating in dog agility, "Survey of Injuries Occurring in Dogs Participating in Agility" in *CR* February 2007 indicated that of the injuries occurring directly from an obstacle, only 7% could be attributed to the seesaw. See **Figures 1 and 2.** The seesaw was responsible for fewer injuries than the A-frame, dogwalk, bar jump, or weave poles. It is fair to conclude that the seesaws presently used in competition are relatively safe.

But can we improve the design of the obstacle? The weight and speed of the dog, the design of the base, the type and location of the fulcrum, and the structure and composition of the board significantly influence how the seesaw responds under load. At five yards per second, the dog may only have tenths of a second to assess the balance point and the obstacle's response. If we build seesaws with precise performance characteristics, the dog can anticipate a predictable response and therefore deliver a consistent and, more importantly, a safe performance.

THE BOARD

The AKC and USDAA specify boards that are 12' long and between 11" and 12" wide, and recommend a surface application to increase traction. The AKC suggests using a plank or panel and the USDAA recommends a sturdy plank. Boards need to be stiff enough to support the weight of the heaviest dogs without bending. In addition, a board that bends can "whip" after it strikes the ground. Our study, "An Evaluation of the Motions of Competition Seesaws" (published in *CR* August 2006 and available online under Articles in the Magazine Forum at www.cleanrun.com/index.cfm?fuseaction=category.display&category_id=447), determined that "board whip" increased as board stiffness decreased. The boards with the least whip used stiff aluminum supports or strong hardwood frames. We concluded that board whip was responsible for dogs' "catapulting" off the board and the "hopping" movement of the obstacle. Attempts to reduce the force of the board at impact using brakes, dashpots, or shock absorbers significantly slowed the seesaw's response.

1



Of the injuries caused by obstacles, the seesaw was responsiblefor only 7%. From "Survey of Injuries Occurring in Dogs Participating in Agility" in CR *February 2007.*

2

Back	6
Stifle	3
Shoulder	3
Metatarsus	2
Forearm	2
Hip	1
Thigh	1
Neck	1
Wrist	1
Tooth	1
Hock	1
Leg	1

Of the 23 reported injuries resulting from the seesaw (7% of all obstacle-related injuries) the back, stifle, and shoulder were most commonly injured.

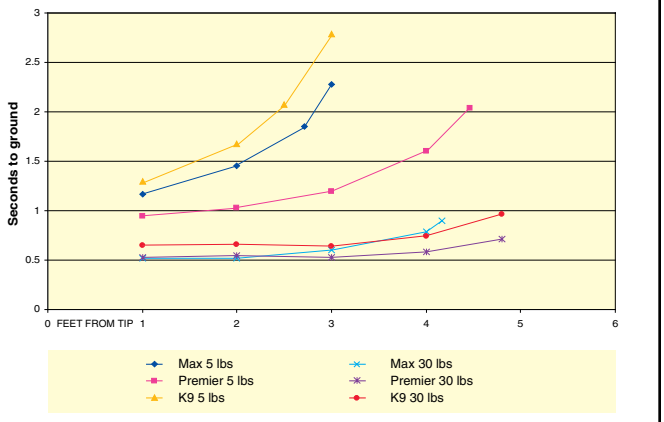
THE BASE

The seesaw base supports the board. USDAA specifications state that the base should be sturdy and both the AKC and USDAA state that the pivot must be visible by a dog approaching from the front of the obstacle. Available base configurations fall into two main groups: triangles and Ts. The triangles can be rigid or collapsible and the Ts can come with support braces or without.

Fulcrums vary as well. Usually one element of the fulcrum is incorporated into the base. Round tube in round tube, round tube in square tube, and thin rods and knife blades with keepers are most commonly used. The tube within a tube construct effectively resists rotation perpendicular to the fulcrum's axis. But it can be variable in its action due to frictional effects. Knife blade fulcrums experience little effect from friction but are less resistant to rotations perpendicular to their rotational axis. The knife blade fulcrum had the most consistent performance for both light and heavy dogs. See **Figure 3** from "An Evaluation of the Motions of Competition Seesaws."

Bases are subjected to loads directed both horizontally and downwardly (applied by the dog) as well as the moments [a tendency to cause rotation about an axis] resulting from the motion of the ascending limb of the board. T-shaped bases and triangles effectively support vertical loads. Horizontal loads stress the vertical limbs of simple Ts if they are not braced. The moments resulting from the ascending limb cause bases to hop and can collapse adjustable triangles. Asymmetric loading of the board can result in twisting at the fulcrum. Captured fulcrums that extend across the width of the board most effectively resist these torsional events around the vertical axis of the seesaw.

3



The knife blade fulcrum incorporated in the Premier Seesaw performed most consistently with dogs of different weights (from "An Evaluation of the Motions of Competition Seesaws," CR August 2006).

THE COMPUTER MODEL

Recently, engineers from the Department of Mechanical and Aerospace Engineering at Case Western Reserve University developed a computer model of a seesaw. The goal was to optimize the seesaw's geometric characteristics for the full range of dog weights. The model takes into account the increasing rate of angular rotation of the board that results from the dog's progress along the seesaw once he passes the fulcrum point. The initial model suggests that decreasing the weight of the board will increase the angular velocity of the board for small

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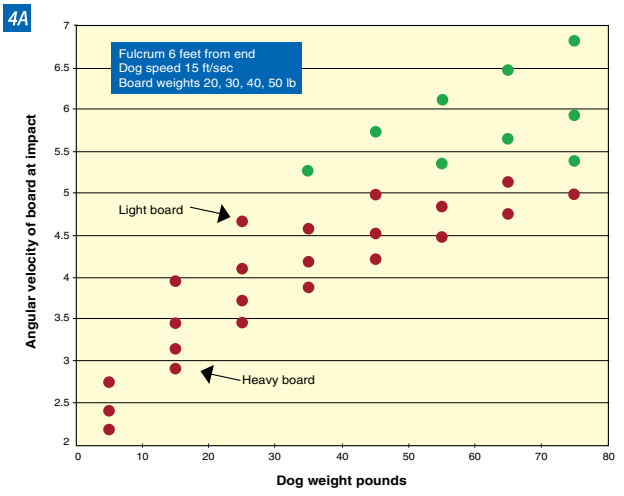
dogs, and for large dogs, to an even greater degree. See **Figures 4a and 4b.** For the model seesaw, when the fulcrum position is moved closer to the center, once again the angular velocity of the board increases, with the greatest increases seen for the heavy dog. Finally, the model indicates that the tipping point moves (dramatically for light dogs) toward the descending end of the board, when the board weight is increased or the fulcrum is moved away from the center and toward the descending end. See **Figures 5a and 5b.**

PERFORMANCE

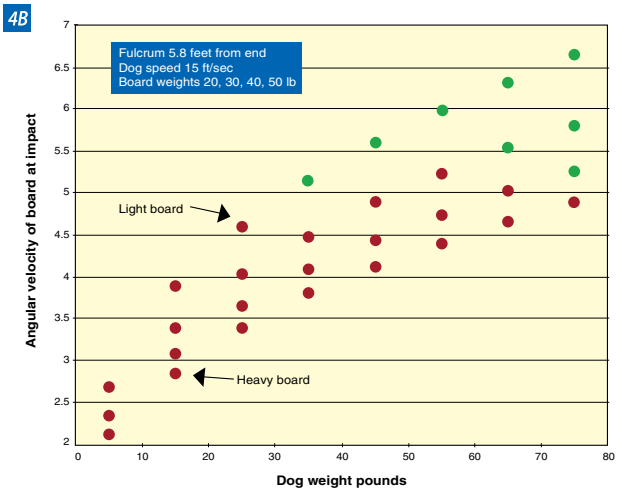
The AKC has attempted to quantify the performance of the obstacle: the plank should be balanced, so that with a 3-lb weight placed 12" from the descending end, it strikes the ground within 3 seconds. Drop studies done with three different boards using five different weights indicated that substantially different performance profiles could exist, all within the AKC's time requirement (see "An Evaluation of the Motions of Competition Seesaws" in *CR* August 2006).

4A



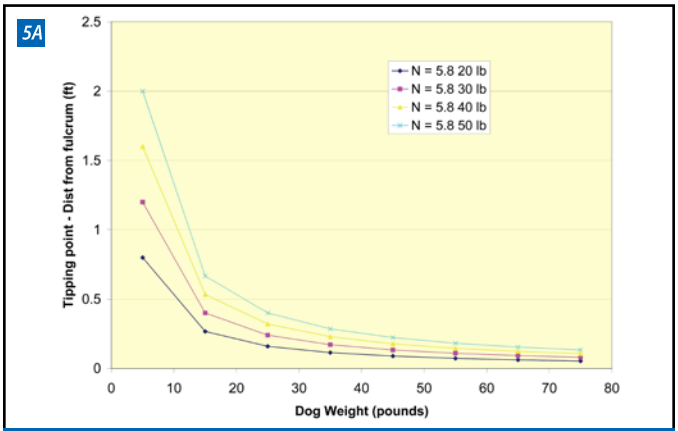
The computer model suggests that decreasing the weight of the board will increase the angular velocity of the board for small dogs and for large dogs to an even greater degree. When the fulcrum position is moved closer to the center of the board, the angular velocity increases, with the greatest increases seen for the heavier dogs.

4B



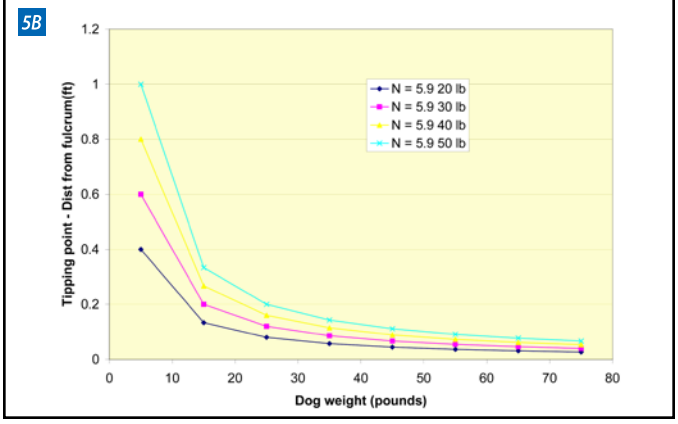
In these two photos, the board whip has caused the seesaw board to bounce back up and lift the dog's rear off the ground, even though the dogs have stopped in their two-on/two-off position.

5A



Change in tipping point as a function of dog weight for seesaws with the fulcrum at 5.8 (A) and 5.9 (B) feet from the tip.

5B



CONCLUSION

So, where do we go from here? To date there is no epidemiological evidence that the seesaw is unsafe. Anecdotal reports of injuries always influence public sentiment; however, our study indicates that the obstacle is associated with a low rate of injury. It is our opinion that the safety of the obstacle can only be improved by making it more consistent in its response. There is no doubt, from both direct observation and computer modeling, that variation of design can significantly influence the response of the obstacle, and recent concerns about the effect of repetitive impact on the dog in training cannot be ignored. Therefore we recommend the following for competition and training use:

- Light boards (20 to 30 lbs) are probably advantageous. The resulting increased angular velocity and displacement of the tipping point toward the fulcrum will aid small dogs. It is important, however, that the stiffness of the board not be compromised, since board whip can become problematic.
- Board responses are faster and more consistent for the full range of dog weights with a knife-blade fulcrum. In addition, they are more predictable for fast-moving dogs. The fulcrum should be firmly captured and extend across the entire width of the board to best resist torsional forces.
- Stiff bases are superior. A braced T-base is stiff in all directions, reduces obstacle wobble, and is easily fixed to the ground with sandbags.
- A shock-absorbing pad of visco-elastic material should be placed on the descending end of the board to dissipate energy. This will reduce shock without changing the response of the board. In addition, it can reduce board whip and base hopping.
- Finally, time adjustments should be incorporated for the smaller dogs. Small dogs take up to 2 seconds longer to tip the board. Adjusting the board with fulcrum resistance, weights, or attenuators just slows the board down for all dogs.

In the final analysis, optimization is nice, but consistency is critical. The governing bodies of the sport now have available to them a means to precisely specify a seesaw's performance. In this way, they can not only improve the dog's performance, but also reduce the risk of injury.

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