Letters to the Editor

Dear Editor,

The distinction between velocity dependence of spasticity from the other characteristic feature of spasticity, namely, the clasp knife phenomenon, is often not stated clearly or quickly discerned. While the lengthening reaction can be easily grasped with the analogy of a clasp knife, velocity dependence lacks an analogy. The underlying neural mechanisms between these two characteristics are different [Figure 1]. Hence, we wish to suggest a car seatbelt as an analogy, so that “velocity dependence” can be easily appreciated.

Several analogies are used to describe hypertonic states [Figure 1], which include spasticity, rigidity, and the less common paratonia. Based on certain key features, spasticity can be easily differentiated from rigidity at the bedside. Rigidity is a nonselective increase in the tone of agonist and antagonist without velocity dependence, and the increased tone remains uniform throughout the range of movement. On the contrary, spasticity is a velocity-dependent increase in tone resulting from the hyperexcitability of stretch reflexes. It primarily involves the antigravity muscles – flexors of the upper limb and extensors of the lower limb. During the passive stretch, a brief “free interval” is appreciated in spasticity but not in rigidity because the resting muscle is electromyographically silent in spasticity. In contrast, in rigidity, the resting muscle shows firing.

Spasticity is also characterized by the “clasp knife phenomenon.” The clasp knife phenomenon refers to the sudden waning of tone after initial resistance [Figure 2], also referred to as a lengthening reaction.[3] This is because of inverse stretch reflex activation mediated by the Golgi tendon organ on sustained muscle stretching resulting in sudden relaxation of the muscle. The underlying mechanism of velocity dependence, which refers to the resistance offered by the muscle to a passive movement that varies proportionally with the speed of movement [Figure 2], is different.[3] This velocity-dependent exaggeration of stretch reflexes is due to increased muscle spindle excitability and velocity sensitivity of la spindle afferents, resulting in excessive activation of alpha motor neurons of the spinal cord.[4]
The analogy of the car seatbelt helps us quickly appreciate velocity dependence and contrast it from the clasp knife effect seen in spasticity. The locking mechanism of a car’s seatbelt is velocity dependent. This protective feature gets triggered, and the seatbelt holds the passenger to the seat when it is stretched beyond a critical velocity, as in sudden deceleration [Figure 3]. The mechanism can also be easily demonstrated by a brisk tug of the seat belt. Also, note that a gentle tug helps in uncoiling the belt before fastening it. Unlike the seatbelt, wherein the catch occurs only beyond a critical velocity, the velocity dependence of resistance in spasticity increases linearly and is proportional to the speed of movement.\textsuperscript{[5]} However, this difference is of little significance clinically.

While other analogies are vintage curiosities (lead pipes in plumbing, foldable pocket-knife, or key-wound wristwatches), our analogy of “seatbelt spasticity” is of much practical relevance today.

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**Figure 1:** Characteristic features, analogy, and pathophysiology of common types of hypertonia. UMN – Upper Motor Neuron. GTO – Golgi Tendon Organ

**Figure 2:** Lengthening reaction refers to the relation between the degree of passive stretch and the resistance to stretch. It is characterized by the sudden loss of resistance. Velocity dependence refers to the relation between the velocity of passive stretch and the resistance to stretch. It is characterized by a proportional increase in resistance with an increase in velocity.

**Figure 3:** During an accident, the passenger continues to lurch forward, momentarily stretching the seatbelt at a high velocity. The velocity-dependent mechanism of seatbelt action gets activated, and it holds back the passenger to the seat.
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Conflicts of interest
There are no conflicts of interest.

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