Thera-Band® ACADEMY

10 myths of elastic resistance: The TRUTH exposed with EVIDENCE!

Phil Page, MS, PT, ATC, CSCS
Thera-Band® Academy

1. There is very little scientific evidence on elastic resistance. FALSE!

There are over 100 published clinical trials that have used elastic resistance. In fact, half of these are randomized, controlled clinical trials, the highest level of evidence available. In addition, there are over 40 basic and applied studies that have been published to describe the scientific foundation for elastic resistance, including electromyographic (EMG) evidence and biomechanical analysis. The most comprehensive and updated list of these references is available at www.Thera-BandAcademy.com.

2. Isotonic or machine-based resistance is more safe & effective than elastic resistance. FALSE!

The injuries and rates reported with using elastic resistance in the literature are as small if not smaller than using isotonic resistance. Scientific evidence proves that the resistance provided by elastics is very similar to isotonic resistance:

- **Similar physiologic responses** (Hostler et al. 2001; Nash et al. 2002; Sexsmith, 1992)
- **Similar outcomes in strength** (Behm 1991; Takeshima et al. 2002; Smockum 2003)
- **Similar patterns of muscle activation (EMG)** (LeBlanc et al. 2003; Lim 1998; Matheson et al. 2001)

Sometimes, in fact, elastic resistance is preferred over machine-based resistance (pulley-resisted or selectorized machines) for several reasons (Page et al. 2000):

- **Elastic resistance provides a strength curve similar to human strength curves** (bell-shaped) as opposed to some rope-and-pulley devices and selectorized machines
- **Exercising at faster speeds does not significantly alter the strength curve** with elastic resistance
- **Eccentric (negative) resistance of elastics is the same as concentric,** opposed to some pulleys that produce twice as much concentric as eccentric force

Torque of Thera-Band — Torque of Rope & Pulley

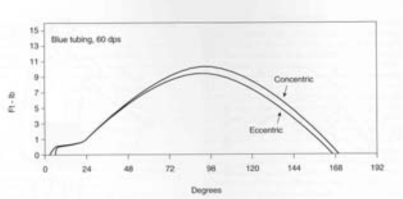


Figure 1.04 Torque curves over 180° for Thera-Band resistive tubing at 60° × s⁻¹.
Data from P. Page and A. Labbe, 2000, "Torque Characteristics of Elastic Resistance and Weight-and-Pulley Exercise," (Abstract). *Medicine and Science in Sports and Exercise* 32(5) (Suppl.):S151.

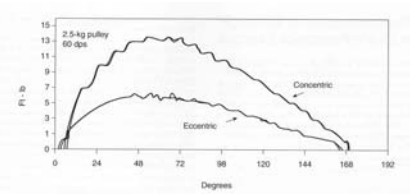


Figure 1.06 Torque curves over 180° for 2.5 kg LOJER pulley system at 60° × s⁻¹.
Data from P. Page and A. Labbe, 2000, "Torque Characteristics of Elastic Resistance and Weight-and-Pulley Exercise," (Abstract). *Medicine and Science in Sports and Exercise* 32(5) (Suppl.):S151.

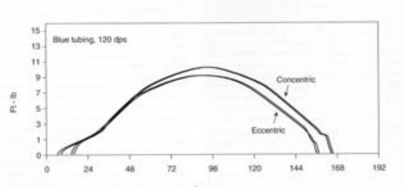


Figure 1.05 Torque curves over 180° for Thera-Band resistive tubing at 120° × s⁻¹.
Data from P. Page and A. Labbe, 2000, "Torque Characteristics of Elastic Resistance and Weight-and-Pulley Exercise," (Abstract). *Medicine and Science in Sports and Exercise* 32(5) (Suppl.):S151.

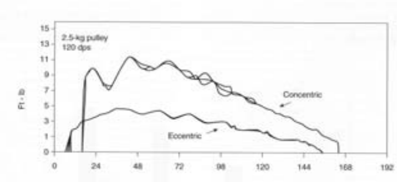
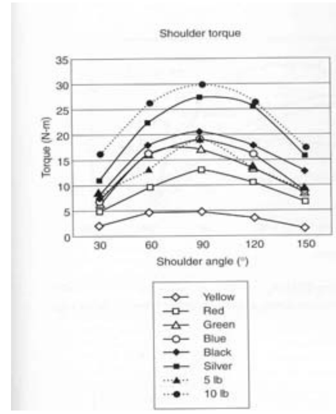


Figure 1.07 Torque curves over 180° for 2.5 kg LOJER pulley system at 120° × s⁻¹.
Data from P. Page and A. Labbe, 2000, "Torque Characteristics of Elastic Resistance and Weight-and-Pulley Exercise," (Abstract). *Medicine and Science in Sports and Exercise* 32(5) (Suppl.):S151.

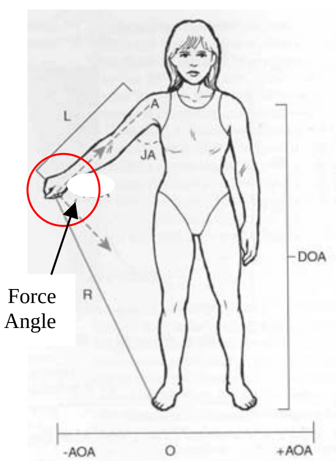
3. In contrast to isotonic resistance, the strength curve (torque at the joint) of elastic resistance is linear & ascending. FALSE!

Many people confuse FORCE (resistance) with TORQUE (force x distance). This has led to the misperception that isotonic resistance is more "functional" to the strength capacity of muscles than elastic resistance. The FORCE produced by elastic resistance is linear and ascending, meaning that resistance increases proportional to amount the band is stretched (percent elongation). This increasing force curve is relatively flat within the clinical elongations (25-300%), and increases exponentially at elongations beyond 500%. The TORQUE (strength curve) of elastic resistance is actually bell-shaped (ascending-descending), similar to human strength curves and isotonic resistance (Hughes et al. 1999; Page et al. 2000).



4. The resistance of bands increases with range of motion, making it difficult to complete the end of the exercise. FALSE!

Even though the resistance of the band increases with range of motion during elongation, the torque produced by the bands at the joint is "bell-shaped", meaning that at the beginning and end ranges, the strength curve profile accommodates the strength curve profile of human strength curves (Hughes et al. 1999; Page et al. 2000). The change in torque occurs as a result of the changing angle between the band and lever arm, known as the "force angle". As the range of motion increases, the force angle decreases, thus changing torque production.



5. The band must be perpendicular to the arm for maximum torque production. FALSE!

The torque (strength curve) of an exercise is determined using the formula, Torque = Force x Distance perpendicular to the Lever arm). This takes the vertical direction of gravity into account in addition to the resistance. The distance perpendicular to the lever arm changes as range of motion increases, and the maximum torque is generally produced where the lever arm is perpendicular to the resistance (as in isotonic resistance). However, unlike isotonic resistance, elastic resistance is not reliant on gravity. Therefore, instead of the distance perpendicular, the sine of the "force angle" (angle between the band and the lever arm) is used to quantify torque. Since the resistance of the band increases and the force angle decreases with increasing range of motion, the maximum torque is often noted at mid-range with proper positioning (Page, 2003).

6. The resistance of bands and tubing is not predictable or quantifiable. FALSE!

The force production of Thera-Band resistance is consistent and quantifiable. The force can be determined by knowing the percent elongation. For example, Thera-Band® bands stretched to 100% (double resting length) provide the following resistances (Page et al. 2000):

Yellow= 3# Red= 4# Green= 5# Blue= 7# Black= 9.5#

	Yellow	Red	Green	Blue	Black	Silver	Gold
25%	1.1	1.5	2	2.8	3.6	5	7.9
50%	1.8	2.6	3.2	4.6	6.3	8.5	13.9
75%	2.4	3.3	4.2	5.9	8.1	11.1	18.1
100%	2.9	3.9	5	7.1	9.7	13.2	21.6
125%	3.4	4.4	5.7	8.1	11	15.2	24.6
150%	3.9	4.9	6.5	9.1	12.3	17.1	27.5
175%	4.3	5.4	7.2	10.1	13.5	18.9	30.3
200%	4.8	5.9	7.9	11.1	14.8	21	33.4
225%	5.3	6.4	8.8	12.1	16.2	23	36.6
250%	5.8	7	9.6	13.3	17.6	25.3	40.1

It's important to note that different colors from different manufacturers may not be as consistent as Thera-Band® resistive bands. While it isn't possible to "label" a specific color of a band as a particular resistance, we *can* state that, "at 100% elongation (double the resting length), a RED Thera-Band® band produces 4 pounds of resistance." Properly positioning the patient will ensure that the strength curve of an isotonic exercise will be similar to the strength curve of the same exercise performed with elastic resistance.

Some have also claimed that the inability to quantify resistance doesn't allow us to assign certain "percent maximums" to appropriately dose elastic resistance intensity. However, a more appropriate method of dosing intensity is to use a "multiple RM" approach, where the resistance is determined by how many repetitions are completed, thus eliminating the need to determine 1RM.

7. Elastic bands stretch out over time with repeated use, thus decreasing the force. FALSE!

Elastic bands and tubing only stretch out after the first few pulls with normal use. Once the material has been "pre-stretched" to about 200%, the length of the material is "set". Therefore, bands experience a small decrease in force after the few pulls, but do not stretch out after the initial setting of the resting length. Patterson et al. (2001), after pre-stretching bands, noted no significant difference in pull force after over 5000 repetitions.

8. The initial length of the band determines the force produced. FALSE!

The force of the band depends directly on the percent change from the resting length (**elongation**), regardless of the resting length of the band (Page et al. 2000). For example, a 1 foot length of red Thera-Band resistance band that is stretched to 2 feet (100% elongation) will have the same force (4 pounds) as a 2 foot length of band stretched to 4 feet (100% elongation = 4 pounds of force for red bands).

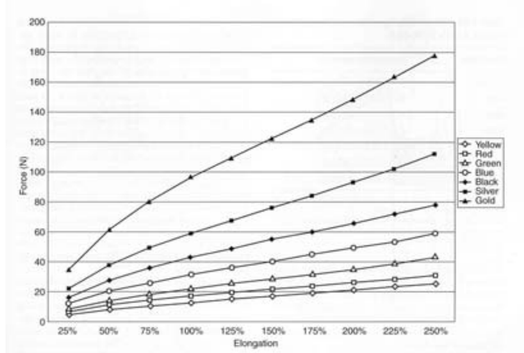


Figure 1.01 Force-Elongation of Thera-Band elastic bands.
Data from P. Page, A. Labbe, and R. Topp, 2000, "Clinical force production at Thera-Band elastic bands," *Journal of Orthopaedic and Sports Physical Therapy* 30(1):A47-8.

9. Elastic resistance doesn't offer enough stimulus to increase strength. FALSE!

In nearly every clinical trial in the literature, elastic resistance has been shown to increase strength. This increase ranges from 10 to 130%, and occurs in a variety of populations, from athletes to older adults. They key is to dose the appropriate resistance levels with the individual, rather than prescribing the same resistance for everyone, since everyone's strength capacity is different. In addition, elastic resistance training has been reported to increase gait and mobility, balance, function, and reduced pain.

10. The best way to progress an exercise resistance is by "shortening-up" on the band. FALSE!

While "shortening-up" on the band does increase the resistance of the exercise, it will also change the overall strength curve of the exercise. Simoneau (2001) demonstrated that grasping the band closer to it's attachment in order to increase the resistance changed the torque of the movement, thus creating a different strength curve for the exercise. In order to maintain the appropriate biomechanics of an exercise, we should retain the same position of the patient while simply using the next color level of resistance band or tubing.

For complete references or more information on elastic resistance, including Frequently-Asked Questions, visit the most comprehensive resource for research and education on elastic resistance in the world: www.Thera-BandAcademy.com

More detail is available in the text, The Scientific and Clinical Application of Elastic Resistance, edited by Phil Page PT & Todd Ellenbecker PT, available from Human Kinetics Publishers at www.humankinetics.com