Orthodontic elastics: Is some tightening needed?

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Nothing in the landscape of orthodontic practice is more trivialized today than are intraoral elastics. Supply companies sell us therapeutic medical-grade rubber bands coded as different countries, animals, colors, nicknames, or sports. They divide our choices further into arbitrary force categories of light, medium, and heavy. While the manufacturers usually provide numerical force values for the basic categories, their numbers seldom agree. Yet, this is the system by which we critically determine our selection of intraoral elastics for the correction of various forms of malocclusion. How often do we pause to scrutinize this shallow, pseudoscientific system we casually embrace to deal with elastic force, an essential ingredient in modern orthodontic practice?

The application of orthodontic elastics in the treatment of interarch discrepancies dates back to the 1890s, when their use was pioneered by Calvin S. Case of Chicago and Henry A. Baker of Boston. First introduced in a natural rubber form, orthodontic elastics have since been engineered in non-latex synthetic forms as well. Intermaxillary anchorage, as it was named, revolutionized the treatment of both Angle Class II and Class III malocclusions. The significant role of elastics in orthodontic therapy over the course of the past century has led to numerous studies, both in vivo and in vitro, whose goals have been to evaluate the force dynamics and characteristics of the variety of elastic materials available on the market. However, during this time, clinicians unwittingly have ceded control over to the commercial suppliers, regarding the standardization of elastic forces. We believe the orthodontics specialty now needs to reexamine this important material of our treatment methods and tighten up its standards of manufacturing, testing, labeling and usage. We need to restructure the measurement of orthodontic elastic forces in a consistent, practical and scientifically intelligible way.

While most manufacturers assign a biomechanical force value, usually in ounces, to each of their elastic categories, the values themselves show an abundance of built-in elasticity. For example, in Michael Langlade's specialized book "*Optimization of Orthodontic Elastics*," the reader is provided a framework for associating the marketing categories of light, medium, and heavy with specific reference values. A medium force, says Langlade, falls within the range of 6 to 10 ounces (170 to 283 grams). This is not only an overly broad range, but it is also significantly above the force values for "medium" stated by most manufacturers. This incongruence is a salient example of the problem with our current orthodontic elastic classification system—that it is, in fact, systemless and without standards.

To gain more insight, we reviewed 11 studies of treatment elastics from the *Angle Orthodontist*, dating as far back as the 1950s. Numerous discrepancies were found in the materials and methods used to perform these kinds of studies, and in the units in which the data were presented. The use of specific units, such as grams or Newtons, was often based upon the investigator's preference, and thus limited the extent to which results could be compared. Only 25% of the studies presented their results in newtons (N), the standard international unit of force in physics. One study erroneously presented its force per millimeter of displacement as a constant value—assuming a linear relation for an elastic material that naturally possesses nonlinear force-elongation characteristics.

Several of the studies found that the "optimal" orthodontic force was generated at stretches as much as 5 times the elastics' lumen size, thus disputing the empirical "rule of 3," which is the manufacturers' informal standard for measuring orthodontic elastic forces. This "rule" instructs that an elastic should be stretched to 3 times its passive inner diameter, and the static force of resistance should then be recorded in grams or ounces from a mechanical strain gauge or similar instrument. This practice is fraught with problems. First, considering the geometry of a circle, an elastic would passively lengthen to 1.57-times its diameter before any real stretching took place. So, a 1/4-inch elastic, following the "rule of 3," would be stretched out to 3/4-inch (0.75 inch; 19.1 millimeters) and its force would be recorded at that point. But the 1/4-inch elastic stretched to 3-times its resting diameter in this manner would actually be active for only

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48% of that stretched length, according to plane geometry, not the two-thirds we would assume. Additionally confounding is the fact that each size of elastic band would be force-measured at a different stretch length. Furthermore, little of this force-testing has direct relevance to the mouth where a stretched elastic band usually spans a distance of 30 to 40 mm in intermaxillary orthodontic applications.

So what may we do to improve understanding and consistency in the application of elastic forces in orthodontics? Most significantly, we must enlist orthodontic manufacturers and suppliers to get actively involved. These commercial entities are ordinarily lax about standardization and critical testing of their basic clinical products, such as elastics. Traditionally, clinicians and academics have had to do most of this work.

Here are some challenges to the industry and the specialty to help upgrade our elastic force standards:

1. Force measurement for every elastic band type needs to be recorded at a standardized static stretch length for consistency required by decision-making clinicians. The present "rule of 3" must be replaced. A standardized stretch length of 40 mm is suggested for force determination, since it is close to the intermaxillary distance from lateral incisor to second molar.
2. Forces in orthodontics need to be measured and reported in newtons, the standard unit of biomechanical force in medical research and practice, to achieve parity with other studies involving applied forces in clinical medicine. The gram as a unit is not a true measure of force and is conceptually ambiguous. And units in ounces are simply unacceptable for international scientific communication today.
3. Packaging and label information must be uniform in the industry to facilitate consumer comparisons among brands of elastic bands. All elastic bags should indicate a standardized lumen size in millimeters and the elastic material's thickness at rest. The resistive force in newtons at the standardized stretch length should be given.

Wouldn't it be nice, also, to be able to go to a manufacturer's website and find there an online "app" that can help us customize elastic forces for a patient? For example, imagine entering values for both interarch distance and desired force magnitude, and clicking "go." The manufacturer's "wizard app," using an algorithm with their elastic force-elongation data, would then suggest the appropriate latex and synthetic elastic products to use based upon these criteria.

If this tightening up of standards is pursued by industry and specialty, orthodontic elastics will finally get the attention and upgrade they have long deserved. As a byproduct, orthodontic treatment surely will be advanced. Orthodontists will have more choices, facts, and understanding. Patients will benefit too. So will manufacturers. With this kind of orthodontic tightening, everyone becomes a winner.