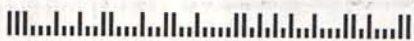
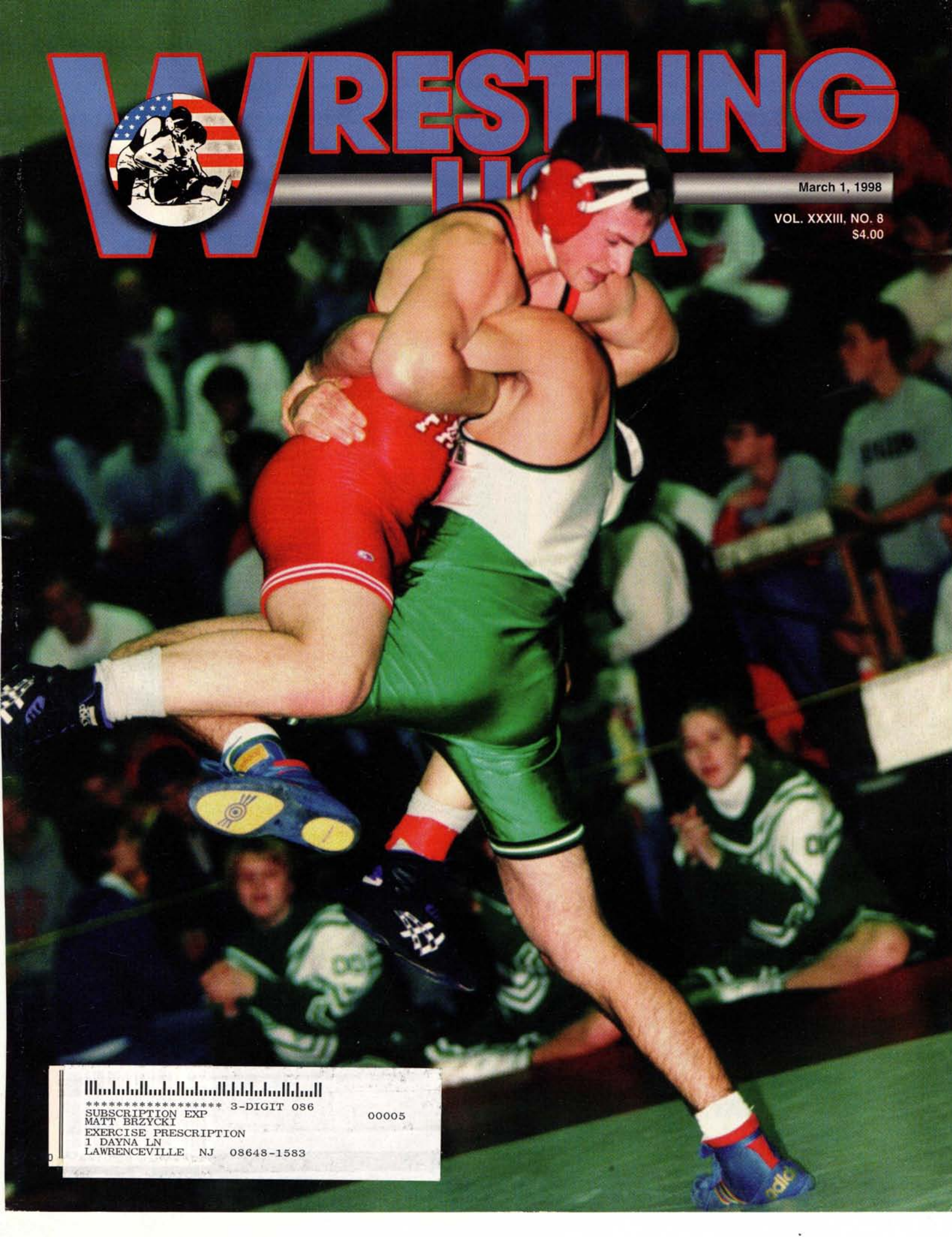


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The Pre-exhaustion Principle: Bypassing The Weak Link

Essentially, there are two types of exercise movements: single-joint and multi-joint. A single-joint movement (also known as a simple or primary movement) involves a range of motion around only one joint. The advantage of a single-joint movement is that it usually isolates a muscle. A good example is a leg extension in which the lower leg rotates around the knee joint thereby isolating the quadriceps muscle located on the front thigh.

On the other hand, a multi-joint movement (also known as a compound or secondary movement) involves ranges of motion around more than one joint. During a lat pulldown, for instance, there's rotation around both the shoulder and the elbow joints—the upper back (or "lats") rotates the upper arm around the shoulder joint and the biceps bend the arm at the elbow joint. The forearm flexors are also used to maintain a grip on the bar. Multi-joint exercises are advantageous because a relatively large amount of muscle mass can be used in one movement.

THE WEAK LINK

There's an old saying that a chain is only as strong as its weakest link. That adage also applies to multi-joint movements. Indeed, multi-joint movements have a distinct disadvantage because they generally have a "weak link." When you fatigue in an exercise it is because your smaller, weaker muscles become exhausted. This happens well before the larger and stronger muscles have received a sufficient workload. In an exercise like a lat pulldown, your biceps are the smaller muscle and, therefore, will fatigue long before your upper back. In fact, your grip strength may be the first to exhaust. Whenever a multi-joint movement is performed for the upper back — such as a lat pulldown or a seated row — the lifter will quickly notice that the biceps and forearms received much more work than the upper back. So, the biceps and forearms get a reasonably good workload but the upper back — which the athlete is really trying to exer-

cise — gets very little workload.

As a rule of thumb, the arms are the weak link when performing multi-joint movements for the upper body. Likewise, the legs are the weak link when performing multi-joint movements for the gluteals (i.e., the hips and buttocks). Because of the existence of these weak links in multi-joint movements, the potential for athletes to develop their larger, more powerful muscle structures is limited. The question is: How can you avoid this problem?

PRE-EXHAUSTION

The problem associated with multi-joint movements can be avoided by utilizing the Pre-Exhaustion Principle — a training technique that was first popularized in the early 1970s. The Pre-Exhaustion Principle employs what has been called a "double set": one single-joint movement followed quickly by a multi-joint movement. With the Pre-Exhaustion Principle, the idea is to "pre-exhaust" the muscles you are trying to work by first performing a single-joint exercise. In effect, this will bypass the weak link. The first exercise is followed quickly by a second exercise to bring into play other surrounding muscles which provide assistance to work the pre-fatigued muscle to a point beyond its normal state of exhaustion. For instance, let's suppose that you want to exercise your

upper back using the Pre-Exhaustion Principle. The first thing you'd do is perform a single-joint exercise — such as a barbell or a dumbbell pullover — to pre-fatigue your upper back. As soon as possible following the completion of that exercise, you'd perform a multi-joint movement — like a lat pulldown or a seated row. That second set will employ your arms to assist your pre-fatigued upper back to work to a degree of exhaustion that would normally be impossible.

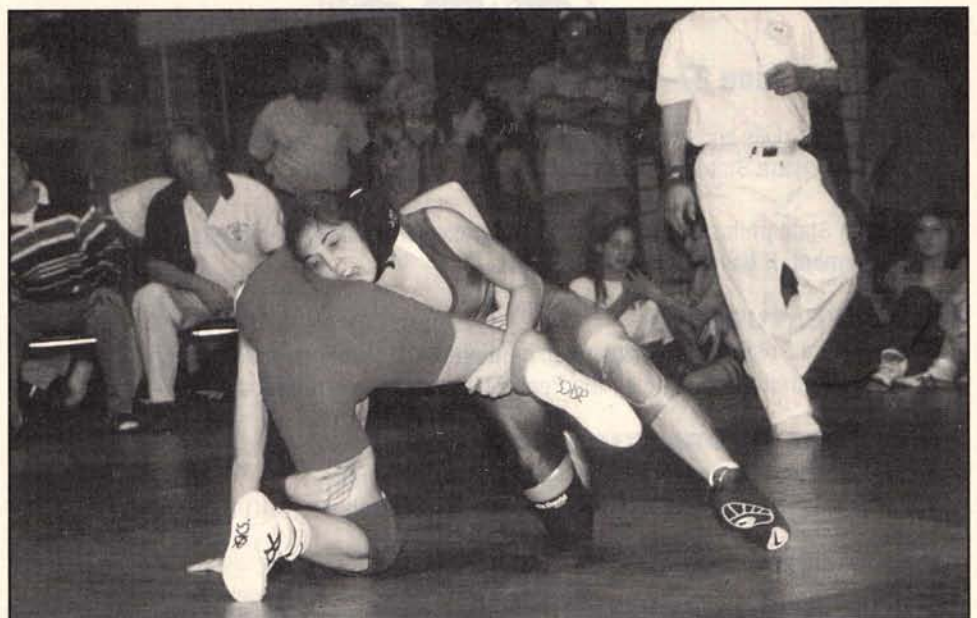
It should be noted that for maximum results, the second exercise should come as soon as possible following the completion of the first exercise. Too much time between the first and second exercises will allow the pre-fatigued muscle to gradually recover some of its original level of strength. If the muscle recovers too much, then you're back to where you started with the weak link still being the limiting factor.

PRACTICAL APPLICATIONS

The following is a brief guide for devising "double sets" to pre-exhaust your major muscle groups:

Gluteals

Individuals fatigue in the leg press when the strength of their quadriceps is exhausted. So, a leg press is a great exercise for developing your front thigh but it is a



1997 Keystone Women's Open - Anne Christensen, Denmark (left) defeated by a near fall in 2:40 by Erin Tomeo, PA, in the 112 lb. weight. Tomeo placed 3rd. Photo by Sonja Stanbro.

relatively poor exercise for developing your gluteals. However, your "glutes" can first be pre-fatigued by performing a single-joint exercise — such as a hip extension or hip abduction (on a machine or with manual resistance). Then, if this single-joint exercise is quickly followed by the leg press, your fresh quadricep and hamstring muscles can be used to fatigue your glutes to a greater degree than would otherwise be possible.

Hamstrings

The leg curl is the main single-joint exercise used to isolate the "hams" on the back of your thigh. Performing a leg press soon after completion of the leg curl uses your glutes and quadriceps to allow you to further exhaust your hamstrings.

Quadriceps

The single-joint movement that is best for isolating your "quads" is the leg extension. Once again, the leg press can be used as a secondary movement. In this case, your glutes and hamstrings are used to exercise your pre-fatigued quadriceps.

Chest

A single-joint movement that provides direct resistance to the pectoral muscles of your chest is the bent arm fly using dumb-

bells or manual resistance. (Actually, this movement also works your anterior deltoid located on the front part of your shoulder.) After pre-fatiguing your chest region with the bent arm fly, your "pecs" can be further exhausted by doing any one of a number of multi-joint movements — depending, of course, upon the available equipment. Popular multi-joint movements for your chest include the bench press, decline press, incline press, push-ups or dips. Performing one of these multi-joint movements soon after completion of the bent arm fly uses your triceps to further exhaust your pectoral area. (It should be noted that for variety, the bent arm fly can be performed in the decline, incline and prone positions.)

Upper Back

Your upper back can be effectively isolated with conventional equipment by using a barbell or dumbbell pullover. Involving your fresh biceps during a multi-joint movement like a chin, pull-up, seated row, bent over row or lat pulldown immediately after the pullover will allow you to exercise your upper back in a highly efficient manner.

Shoulders

Your shoulder musculature includes

the deltoids and the trapezius. The most popular singlejoint movements for addressing the muscles of your deltoid using conventional equipment are the lateral raise (middle deltoid), front raise (anterior deltoid) and bent over raise (posterior deltoid). A shoulder shrug is the best single-joint exercise for isolating your trapezius. A "double set" for your deltoids would include one of the three single-joint exercises for the deltoids followed quickly by a shoulder press. The shoulder press uses your triceps to assist in exercising your pre-fatigued deltoids. A "double set" for your trapezius would be the shoulder shrug followed as soon as possible by an upright row. The upright row uses your biceps to help pre-exhaust your trapezius.

Biceps

The bicep curl is the best single-joint exercise for isolating your bicep muscle. Located on the front part of your upper arm, your biceps are used to flex your lower arm around your elbow joint. Performing a multi-joint movement like a chin, pull-up, seated row, bent over row or lat pulldown soon after doing the bicep curl allows you to use your upper back to exhaust your biceps even further.

Triceps

Your triceps are found on the back of your upper arm and are used to extend your lower arm around your elbow joint. The single-joint movement that is best for exercising your triceps is the tricep extension — which can be done standing, sitting or laying. The bench press, decline press, incline press, dip or shoulder press can be used as a multi-joint movement. In this manner, your chest and/or anterior deltoid are used to exercise your pre-fatigued triceps.

THE BOTTOM LINE

Remember, the limiting factor in multi-joint movements is the smaller, weaker muscle structures. However, the disadvantage can be turned into an advantage by first pre-fatiguing your muscles with a single-joint movement and then immediately performing a multi-joint movement to involve surrounding muscles for assistance. In this way, you'll maximize your muscular development in a safe, efficient manner.

Editor's Note: Matt Brzycki is the Coordinator of Health Fitness, Strength and Conditioning Programs at Princeton University.

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