Chains reaction

by Stuart Miller

You may well have observed them in use or tried them for yourself. Using chains and rubber bands is proven to increase resistance within any given exercise. Here we compare them to normal equipment and to each other, and offer some insights to guide your own choice.

The point about conventional free-weight-based lifts is that they are classified as isoinertial. That is, the mass you are lifting is not changing: you are lifting the same mass at the beginning as you are at the end. However, because our bodies cannot produce the same external force at different joint positions, you will only be able to lift the mass that you can move at the weakest point in the lift (ie, at your 'sticking point').

There are three associated factors here (see Hard Science panel):

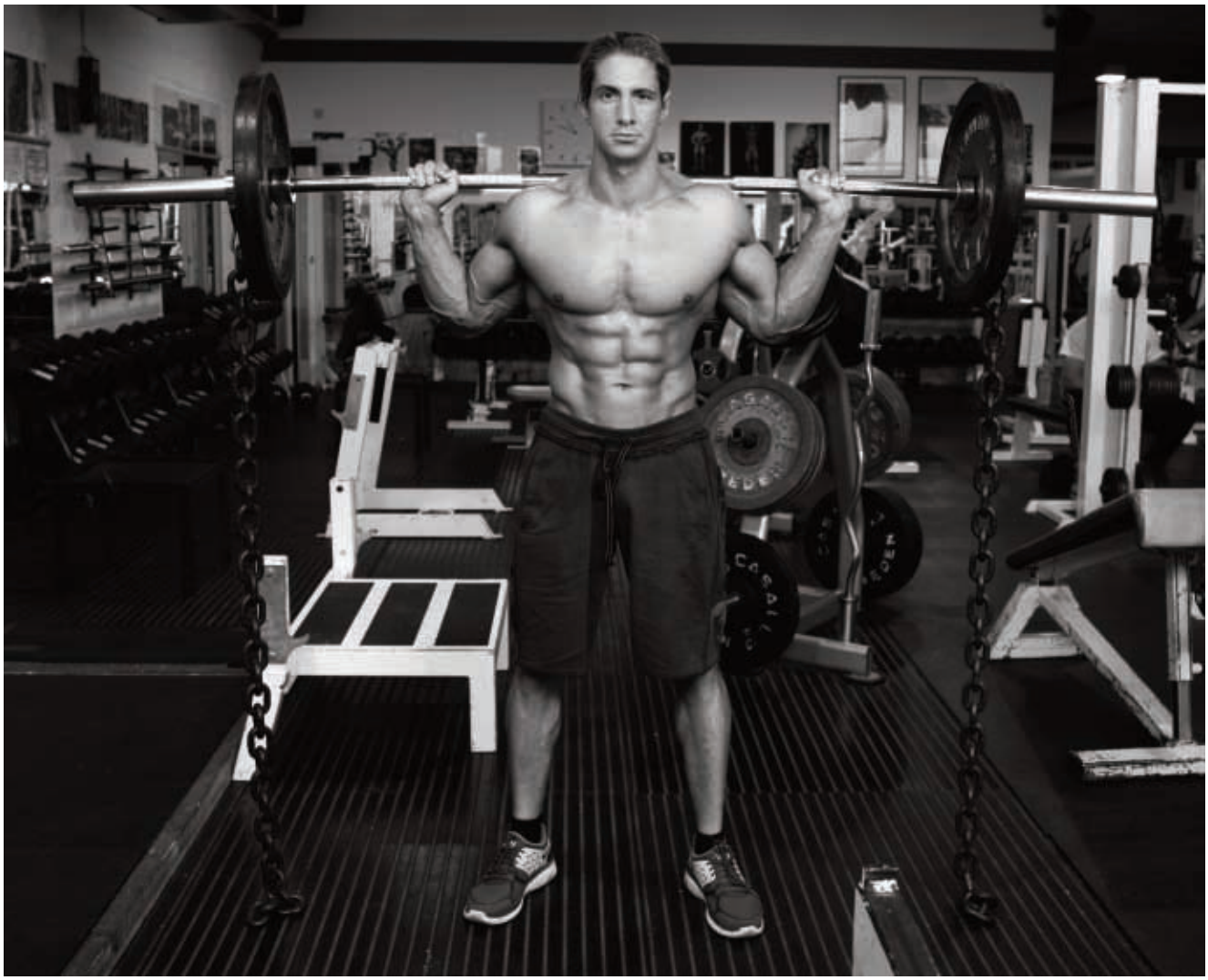
- the force–length relationship of the muscle;
- the internal moment arm of the muscle–tendon unit;
- the external moment arm of the limb.

Depending on the lift, we can be weaker at the top, bottom, or within the middle part of the movement; if you are going to fail a lift, it will occur here, at your sticking point.

Stress management

Based on this, it holds that we are not then stressing our muscular system consistently throughout the whole lift. It would be stressed more (ie, required to work harder) during the part of the lift where the body is at its weakest, as opposed to at the point where it is in a stronger position.

An example of this would be the back squat. It is possible to lift much more when performing a ¼ squat than if you were to perform a full squat. This is because your body is in a



stronger position mechanically, at the top of the squat. When you get lower, your body becomes mechanically weaker, resulting in less external force being produced to move a given mass.

The design of machine weights is an attempt to control for this, by using a cam within the pulley system. This alters the mechanical advantage produced by the pulley to tie in with the various positions of the lifting movement. However, because we are all made differently, and train as individuals, one cam does not fit all. In addition, different manufacturers use different sizes and shapes of cam (probably due to copyright issues).

Stretch to fit

Consequently, chains and bands have been introduced as a more flexible, individualised, method of allowing us to stress our system throughout the whole lift.

By applying chains and bands to the bar lifted, we are able to change the mass lifted throughout the lift. For example, within the back squat, the chains would hang down at both ends of the bar. When we are at the top of the lift (the strongest position), most of the chains are off the floor, adding more mass to the bar. As we squat down (towards the weakest point of the lift), more of the chains are on the floor, thus reducing the mass that we have to lift.

Studies assessing this strategy have produced a range of supporting data to suggest that the theory meets the reality. Performing the back squat with bands produced a greater activation in the vastus lateralis (one of the four quadriceps muscles) at the top of the lift, but no change at the bottom, when compared to completing the lift with no bands attached [1].

Chains or bands?

More elite British powerlifters implement chains (57%) within their workout, compared to bands (39%) [2]. Of course, just because it is a majority choice does not mean that it is the best choice for all of us! There is a difference between how bands and chains alter the lift. Chains apply more resistance in a linear increment, whereas bands increase their resistance in a curvilinear effect (due to their viscoelastic properties) [3]. Therefore, the choice of method is likely to be dictated by the sequence of body strength change during the lift – is it linear or curvilinear? When the body changes more in a curvilinear pattern, the application of bands may be more beneficial.

HARD SCIENCE

The force we can apply to an external resistant is determined by three main factors. These all interplay differently in each lift. As a result, there is not one general conclusion for all lifts.

- **The length of the muscle:** all the skeletal muscles produce force dependent on the length of the muscle. When held at its 'resting' length, a muscle is able to produce maximal force. When in a shorter or longer position than resting length, the muscle is weaker. However, muscle length change is constrained by mechanical restrictions at the joint – that is, we are unable to stretch a muscle to its actual maximum length where the joint will not allow this. As such, different muscles extend along different sections of the force–length relationship within the body.
- **The muscle–tendon unit moment arm:** the distance between the tendon of the muscle, and the centre of the joint it rotates, is termed the 'moment arm' and influences the effect the muscle force has on the joint. The rotary strength we see at the joint (termed 'joint torque') is a product of the muscle force and the moment arm (torque = force x moment arm). The moment arm changes as the joint rotates, resulting in a change in the ratio between muscle force and joint torque.
- **The external moment arm:** imagine a vertical line travelling through the mass you are trying to lift. The relative location of this line where it passes by the joint centre of rotation is termed the external moment arm. The smaller the distance away, the less torque is required to move the mass. Hence the hardest portion of the bicep curl is when the elbow is at 90°, when the external moment arm is at its largest.

Chains may be hard to come across, and even harder to carry around. However, rubber bands are easily available (the coloured bands that physiotherapists use within rehabilitation are appropriate). Bands are also more adaptable; they can become the only resistance within a movement, or allow addition to an already present resistance.

Future research

Broadly speaking, a consistent increase in strength has been established when either bands or chains are applied to the training environment. However, the specific differences between the two are yet to be determined.

Also, along with the benefits of increased peak force during a lift for both bands and chains, data have demonstrated negative effects on movement velocity, peak power, and peak rate of force development [4], although the training outcomes of these changes – if any – are yet to be established.

The bottom line is, if you want to increase muscle size and strength, then the addition of bands or chains will help. Working your muscles maximally through the full lift will allow you to stress your system more – which enhances the effects of the training.

References

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