The different forms of muscle energy technique

1

When you bend your knee (or any other joint), a muscle or group of muscles contracts in order to produce the desired movement. The active muscle(s) in bending the knee are the hamstring group on the back of the thigh. The active muscles in any action are known as the *agonists*.

At exactly the same time another set of muscles relaxes, so that the movement will be produced in a smooth coordinated manner. When the knee bends it is the muscles on the front of the thigh that relax in this way, the quadriceps. These muscles, which are capable of performing precisely the opposite movement if they contract (i.e. straightening the knee), are known as the *antagonists*.

The coordination between the opposing muscles of any area is automatic and it happens without conscious effort. It depends upon a physiological law which declares that contraction of any muscle will produce, under normal conditions, relaxation of its antagonist.

When we speak of muscles being antagonistic, we of course do not mean that they have a grudge against each other. Rather, it indicates that one muscle's action will be directly opposed by another's. They balance each other and thus work together cooperatively by virtue of the one releasing its contraction, and relaxing, as the other contracts, to produce coordinated movement.

Take another example, the elbow. As the muscles on the front of your arm (the flexors) contract, in order to allow you to lift a glass to your lips, so the muscles on the back of your arm, the extensors, relax, in order to allow this to happen smoothly without jerking or hesitation. The flexors in this example are

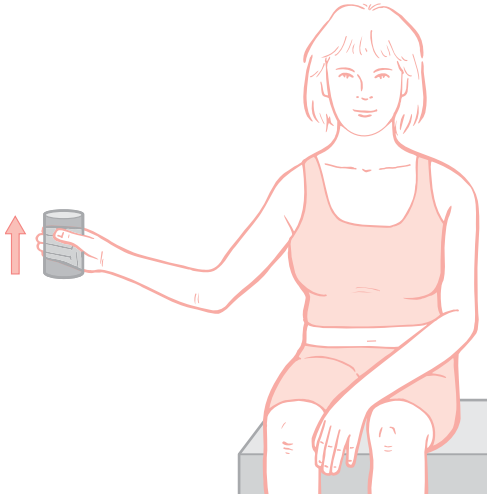

Figure 1.1 *Lifting a glass of water is achieved by a concentric contraction*

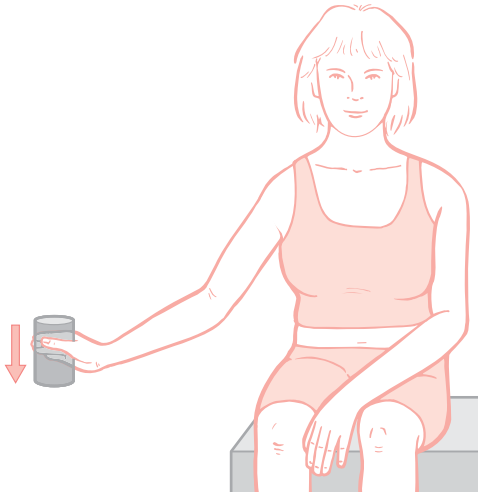

Figure 1.2 *When you put a glass down the muscles are contracting while they are lengthening. This is an eccentric contraction*

contracting and as they do so they are getting shorter. This is called a *concentric contraction* (see Fig. 1.1).

While this is happening it is important for the antagonists to continue to exert some effort, in order to maintain stability. If they were completely relaxed (e.g. paralysed) then the movement would be uncontrolled, uncoordinated, spastic and jerky (as occurs in people with nerve damage such as in cerebral palsy).

When it is time to put the glass down again, the opposite happens. As the extensors straighten out your elbow, the flexors, in a controlled manner, release their hold on your bent elbow joint.

In this particular example, the flexors of your arm (which bent it in the first place) do not just release all effort or there would be a sudden straightening of your arm and the glass would smash onto the table. Rather, they continue to contract but while they are doing so, they get longer and release the pull on your elbow. Being able to contract and at the same time stretch is a most important muscular facility. This is called an *eccentric contraction*.

To use MET efficiently we need to be aware of the fact that muscles are mutually antagonistic to their opposite numbers and that this offers us a wonderful way of making tight muscles relax. The automatic quality of an antagonist relaxing when its opposite number is tightening (contracting) is known as *reciprocal inhibition* (see Fig. 1.2).

The integrated manner in which the nervous system controls muscular tension, and the importance in this process of minute reporting stations in the soft tissues, have provided the osteopathic profession with an understanding of the way all this happens. How can we use this knowledge?

EXAMPLE OF RECIPROCAL INHIBITION IN MET

If the muscles of the front of your arm, to stay with that example, are tense, say after gardening, tennis or an injury, you could use the muscles on the back of your arm to relax these tight muscles. If you took that arm to its maximum comfortable degree of straightness, ensuring that in doing so it does not produce pain (which it would if it went beyond its present restriction barrier), and at that point, whilst restraining your lower arm with your other hand (i.e.

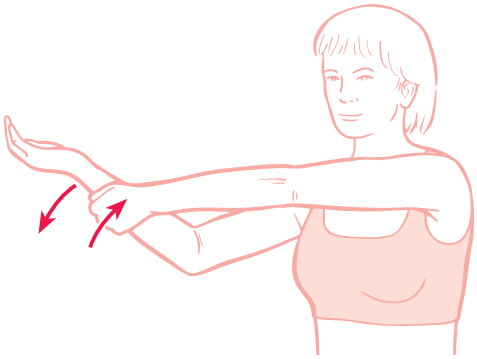

Figure 1.3 *When the flexor muscles are tight, trying to straighten the arm against resistance without movement taking place at all (an isometric contraction of the antagonists) relaxes the flexor muscles by reciprocal inhibition*

preventing it from moving), tried to gently take your arm towards a greater degree of straightness, by contracting the muscles of the back of your arm, what would happen?

As you tried to make your arm straight (i.e. pushing gently towards the restrictive barrier) you would be contracting the muscles of the back of your arm. These are the antagonists of the tight muscles which are in trouble and by preventing any movement from taking place (by using your other hand), it is possible to ensure that no strain occurs at the painful joint or in the tight muscle(s). You would in effect have a matching of forces. The extensor muscles would be trying to pull your arm straight, while your free arm resists this, completely and exactly. This is called an *isometric contraction*. The forces match each other and no movement occurs (see Fig. 1.3).

As this isometric contraction of the extensor muscles is taking place to try to straighten your arm, their antagonists (the shortened flexors) would be obliged to relax, according to physiological law. Therefore, after this MET isometric effort, which could last for 5–10 seconds, you would find that the arm which was previously limited in its ability to straighten would be capable of an increased degree of normality.

The barrier, or *point of bind*, would have been pushed back a little as the flexor muscles relax. By repeating this whole procedure several times, until no further gain in the range of movement is noted, it might be possible to completely normalize the shortened muscles.

What I have described above is an example of an isometric contraction of the extensor muscles. These are the antagonists to the short flexor muscles (the agonists), and we would be using reciprocal inhibition (RI) to achieve the objective of 'switching off' the tight flexor muscles, allowing them to be more easily stretched afterwards.

Achieving postisometric relaxation in an MET procedure

There is another, completely different method for achieving the same objective, in order to relax the tight flexor muscles.

If your arm, with its limited ability to straighten, is taken as far as it can comfortably go in that direction (to the current painless barrier of movement) and this time you try to *bend* your arm, instead of making it straighter, and if this effort to bend your arm is resisted by your other hand, you will be doing

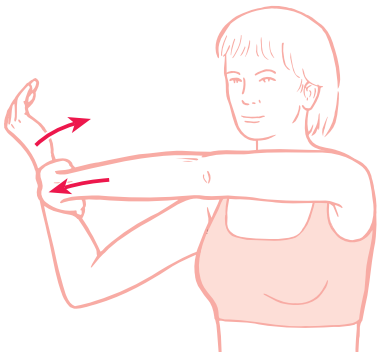

Figure 1.4 *Contracting the shortened muscles against resistance so that no movement occurs (isometric contraction of the agonists) produces postisometric relaxation (PIR)*

the opposite of the previous example which involved reciprocal inhibition. Your arm, having been taken to the point of restriction/bind, would be trying to bend, but the counterforce of your restraining hand would stop it from doing so, isometrically (see Fig. 1.4).

This time, the very muscles which had shortened (the agonists) would be contracting against resistance and, after an appropriate period, say 5–10 seconds, of this isometric contraction (no movement allowed to occur, only effort) a new phenomenon would become apparent. This is called *postisometric relaxation (PIR)*. This means that any muscle, or group of muscles, which is isometrically contracted *is obliged to relax* afterwards. So if a muscle is tense or tight and it is then isometrically contracted, it will, to some extent, release and relax afterwards, allowing it to be more easily stretched afterward. A more detailed look at the use of PIR and RI, in the elbow example, will be found in Box 1.1.

Box 1.1 Detailed examples of the use of PIR and RI

USE OF PIR

Let's look more carefully at MET treatment of an arm with some degree of muscular shortening, making it difficult to straighten fully. Let us say this is the right arm. The first objective in any MET procedure is to establish what the restriction barrier is, whether this relates to an arm that won't fully straighten or any other joint that has a limitation in its normal movement. To establish its restriction barrier, the arm should therefore be taken gently to the limit of the available degree of movement, in the direction in which it is restricted. Going too far would force it beyond the current barrier and would actually irritate the tissues of the area, so it should therefore be stretched out gently, until the 'point of bind' is felt, beyond which discomfort would start.

When you are trying to release and stretch tissues which are chronically short (this usually means they have been that way for a month or more) then the isometric contraction should start with the arm (in this example) just short of the restriction barrier or point of bind.

If the condition is acute (less than a month old or acutely painful) the contraction should start at the restriction barrier. The degree of effort used in acute and chronic conditions also varies, as you will see below.

Sitting at a table, the right arm could be rested on it (possibly on a cushion), as straight as it is comfortably possible to do, with the left hand placed at about wrist level in order to restrain a contraction of the muscles which bend the arm (the very ones which have shortened and which are preventing full straightening).

As the attempt is being made to bend the arm, the counterpressure from the left hand should prevent this. Only about a quarter of the available strength of the muscles of the right arm should be used, with the start of the contraction synchronized with the counterpressure, to avoid any jerking. This contraction should be maintained for a slow count of 7–10 before being slowly released, in a coordinated manner, together with the release of the counterpressure from the left hand.

After a moment during which the arm is relaxed fully, an attempt should be made to take the arm to its fullest, pain-free, stretched-out length (an inhalation followed by a slow exhalation can be used to make this more effective; see below). This stretch should push just beyond the previous restriction barrier if the condition is chronic (an old problem, of more than a month's duration) and just to the barrier if it is acute (a more recent, or an acutely painful, problem).

Thus a new barrier would be engaged and there should be a greater degree of movement than was possible before the isometric contraction. It should now be possible to take the arm a little straighter without effort. In a chronic condition, if stretching is being carried out, this stretch should be held for not less than 30 seconds, to give the shortened muscle tissues a chance to lengthen. In an acute condition, there is no stretching so the next isometric contraction can be perfomed straight away.

Whether acute or chronic, the whole procedure is then repeated at least once more, exactly as above, and once again, after coordinated release of the contraction and the counterpressure, another attempt could be made to see just how straight the arm could go, painlessly, either to a new barrier if acute or to a new stretched position if chronic.

USE OF RI

If the attempt at contracting the shortened muscles (agonists), as described in the exercise above, was painful, it would be appropriate to use the antagonists instead; in other words, using reciprocal inhibition to 'switch off' the tight agonists. RI is often more useful than PIR in acute conditions.

To do this, the arm should again be taken to its full comfortable resting length, with the elbow on the table, and this time the left hand is placed on the back of the wrist, as a counterforce. This time the effort would involve the extensor muscles, which would try to force the arm into a greater degree of straightness, against resistance from the other hand. Again, only partial strength is used and the timing is the same as above, starting with a 5–10-second contraction.

After a slow easing of the dual efforts (the arm trying to straighten against resistance), the arm would again be tested to see if it could achieve a greater degree of normality in straightening.

Several attempts of this type should be made, increasing the length and degree of effort (always ensuring that no pain is produced and only increasing the amount of muscular effort if the condition is chronic), until it becomes evident that no further gains could be made and at this point muscle energy methods should be stopped for the day.

Both PIR and RI would have been used and maximum gains enjoyed in terms of greater degree of movement and lessened discomfort.

Variations in the direction of the contraction are possible during these various isometric efforts, in which different angles of bending or straightening are resisted, thus using different muscle fibers. For example, the hand of the arm resting on the table could be aiming for the face, as the contraction begins, or it could be aiming for the right or left shoulder.

These variations in direction are always possible when trying to normalize tight muscles and should be incorporated into the variables of amount of effort used, amount of time of each contraction, number of contractions and type of contraction (PIR or RI).

Other variables in the previous example could include the position of the hand on the affected side during the contractions. This could be palm downwards or palm upwards, thus bringing different muscles into play. All such factors will be outlined as appropriate, in the descriptions of the various muscles and joints in the text.

SUMMARY

- By using the affected (tight, shortened, etc.) muscle(s) in an isometric contraction we induce postisometric relaxation (PIR) in the affected muscle(s). This offers an opportunity to stretch the previously shortened muscle(s) afterwards.
- By using the antagonists of affected muscles (tight, shortened, etc.) in an isometric contraction we induce reciprocal inhibition (RI) in the affected muscle(s). This also offers an opportunity to stretch the previously shortened muscle(s) afterwards.

These are two of the most important aspects of the release of troubled muscles and joints using MET methods and I will be repeating these basic instructions many times during the course of this book.

In the many examples of MET in the book, different forms of counterpressure will be used. In some cases, the resistance to your contracting muscle(s) will be provided by your own or someone else's hand(s); in other instances it will be provided by an unyielding obstacle, such as a piece of furniture or a wall, against which effort can be directed, and in other cases the counterforce will be gravity.

In all of these examples, the aim is to use the affected muscles or their antagonists appropriately, in order to achieve the release of tense, tight, shortened muscles, which are often painful and which usually produce some degree of limitation of movement.

Which method should be used – PIR or RI

The presence of pain is frequently the deciding factor in choosing one or other of the methods described (PIR or RI). It is clear that when using PIR, the very muscles which have shortened are being contracted. If the area is already painful and any contraction could well trigger more pain, it might be best to avoid using these muscles and choose instead the antagonists. The antagonists, which are usually pain free, might well be your first choice for MET use, when the shortened muscles are very sensitive. Later, when pain has been reduced by means of muscle energy (or other) methods, PIR techniques (which use isometric contraction of the already shortened muscles rather than the antagonists used in RI methods) could be used. To a large extent, deciding whether a condition is acute or chronic can determine the method best suited to treating it and advice regarding this will be found later in this chapter.

Thinking back to the example of the arm which is putting down a glass, you will recall that muscles are capable of both contracting and lengthening at the same time. This should help an understanding of other MET procedures, the isotonic variations.

Isotonic MET methods

CONCENTRIC ISOTONIC CONTRACTIONS

When the muscles of your arm contract as you bring a glass to your lips, they are both contracting and shortening. Technically this is called a *concentric isotonic contraction*. This means that the two ends of the muscle(s), the origins

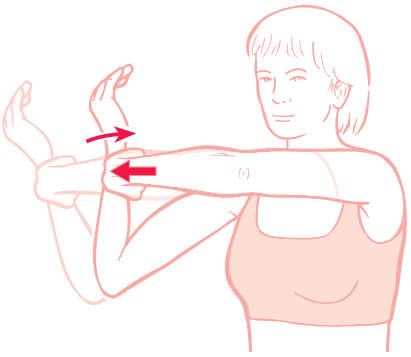

Figure 1.5 *The arm is being flexed against a degree of resistance which does not fully match the effort of the arm. Therefore an isotonic concentric contraction is taking place, toning/strengthening the arm muscles that are working.* ***1*** *start (more distant from face).* ***2*** *new position*

and insertions, that are contracting are getting closer together. This is what people do when they lift weights and, as is obvious from that activity, this helps to tone, strengthen and 'build' muscles. So we can usefully introduce concentric isometric activities when we want to achieve increased strength and tone (see Fig. 1.5).

In isotonic concentric contractions the effort of the contracting muscle is resisted but not quite overcome. The movement is allowed to take place, with effort. Should a group of muscles be weak, after disuse for example, and should you wish to tone these up, you have a perfect tool in concentric isotonic methods of muscle energy.

Now let us assume that the flexors of your arm (which bend your elbow) are weak, for whatever reason. If your opposite hand were placed on your forearm to partially restrain an attempt to bend your arm then, as they contracted, the weak muscles would be working against a degree of resistance. By repeatedly doing this, with variations in the degree of resistance applied, it would be possible to strengthen the weak muscles.

A variation exists where an area is rapidly and repeatedly moved in a variety of directions, while being partially resisted. This would produce a series of concentric isotonic contractions, known as an *isokinetic exercise*. An example of this could involve a weak ankle; while sitting with the affected leg resting across the other knee, you could use your hands to restrain a forceful effort to put the ankle joint through as full a range of movements as possible, in a short space of time (no more than 5 seconds). This has a powerful toning effect on the whole joint.

ECCENTRIC ISOTONIC CONTRACTIONS

In contrast to this last example, when your arm is putting a glass down, the muscles will be contracting but despite this they are also lengthening. Technically this is known as an *eccentric isotonic contraction*. Here the muscle's origin and insertion (where the muscle attaches into bone as an anchor point) get further apart, despite the contraction of the muscle. This can be used to dual effect in particular exercises, especially if performed very slowly (note: a slow eccentric isotonic stretch is abbreviated as a SEIS in this text). The two effects of a SEIS are to tone the muscle that is slowly eccentrically stretching, while at the same time this activity is creating a reciprocal inhibition of its antagonist, so allowing the antagonist to be more easily stretched afterwards. See the notes on the diaphragm and pursed lip breathing in Chapter 6 for an example of an exercise that uses eccentric isotonic activity (see Fig. 1.6).

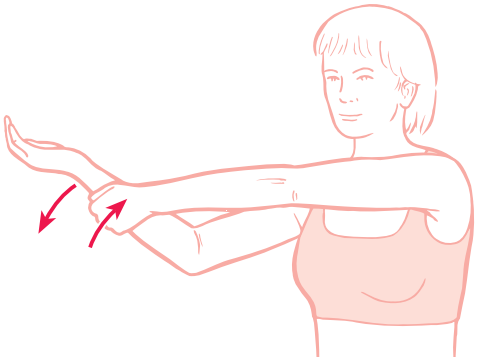

Figure 1.6 *The arm is being forced to bend as it tries to stay straight. The effort of the arm is being overcome, stretching the contracting extensor muscles of the arm (an isotonic eccentric contraction), toning them while at the same time inhibiting the tight flexor muscles (which can be stretched after this maneuver is finished)*

The major variables in MET

As in all the examples given, the essential features defining different uses of MET are:

- the amount of effort used in the contraction
- the amount of effort used in restraining a contraction, i.e. whether the contraction is matched (isometric) or overcome (isotonic eccentric) or only partially resisted (isotonic concentric).

The other major variables which are controllable are, of course, how long the contraction is allowed to continue and how often it is repeated.

- The degree of effort in isometric contractions should *always* be much less than the full force available from the muscles involved. The initial contraction should involve a quarter or less of the strength available. This, of course, will not be an exact measurement but indicates that a wrestling match should never develop between the contracting area and the counterforce, whether this be a hand, a piece of furniture, another person's hands or gravity.
- After the initial, slowly commenced contraction, subsequent contractions may involve an increase in effort but should never reach more than half of the full strength of that muscle. We want above all to achieve a *controlled* degree of effort at all times and this calls for the use of only part of the available strength in a muscle or muscle group.
- The timing of isometric contractions is usually such as to allow at least 5 and up to 10 seconds for the contraction, from beginning to end.
- It is important to remember that the start and the end of contraction should always be slow. There should never be a snatching or a quick beginning or end to the contraction. Always attempt a smooth build-up of power in the muscle(s) and a slow switch-off of the contraction at the end. This will prevent injury or strain and produces the best possible results.
- In some cases slightly shorter periods of time are suggested for the contractions and in others they will be longer. Indeed, in many instances there is a variation as the therapy progresses, with even longer periods of time involved, although 30 seconds would be a top limit, unless otherwise stated in the text. *It is far safer and more effective to contract a muscle for a longer period than it is to make the contraction stronger.*

- Use of breathing and eye movements can help some applications of MET (see Box 1.2).

Guidance as to these variables will be given in the individual examples later in the book. As a rough guide, though, the 5–10-second timing of initial isometric contractions is a useful rule to bear in mind. Repetitions are normally continued three or four times, although usually only for as long as improvements continue to be achieved in the problem muscle(s) between contractions.

Box 1.2 Influence of breathing and eye movements on MET

BREATHING

Another factor relating to these methods which has not been explained up to now is the use of breathing patterns to enhance the effects of PIR and RI.

In some cases it is necessary to breathe in deeply at the onset of a contraction and to hold the breath for the duration of the effort, releasing the breath at completion, as relaxation is taking place. In other instances it is helpful for the breath to be sighed out as the effort commences and for this to be held out until the end of the contraction.

In all cases it is desirable that after the contraction, and before any attempt is made to assess the degree of extra movement achieved, a full breath be taken and slowly sighed out, to help release all muscular effort.

The reason for the suggested breathing patterns during isometric and isotonic contractions is that there is evidence that certain muscle movements are helped by one or other phase of the breathing cycle. For example, if you bend towards your toes whilst breathing in, you will not be able to reach as far as if you bend whilst breathing out. This is true for many other movements of the body as well. Bending the neck forward and general side bending are two examples of this. The neck and low back are easier to bend backwards as you breathe out, whereas the thoracic spine is easier to bend backwards when the breath is being taken in. For instance, a bending forwards of the thoracic spine (where the ribs attach) is made easier by breathing out, whereas the reverse is true if this area is being bent backwards.

There is therefore an advantage to be gained by using the breathing phase that is most helpful in any given movement. (Guidelines to these will be given in the text of individual exercises where this is useful.)

EYE MOVEMENTS AND MET

If you try to bend forwards whilst looking upwards (with the eyes only, without any movement of the head), you will not be able to bend as far, or as easily, as if you were looking downwards. The converse also applies to coming upright from a bent position with the eyes looking downwards. So, when you bend forwards while looking down, the movement becomes easier while straightening up from such a bend, or actually bending backwards, is easier with the eyes rolled upwards.

Eye involvement is important in other movements as well. Try this experiment. Sit in a chair and turn your trunk and head to one side, while your eyes are looking in the opposite direction. Note how far you can go without undue strain and make a mental note on the wall, indicating your furthest point of rotation. Then do the same turn exactly but this time have the eyes traveling in the same direction as the turn. You will find that you can go much further because the rotation of the body is improved by the direction in which the eyes are looking. (Guidelines to these variables will be found in the text.)

Pulsed MET

There is another MET variation, which is powerful and useful. This is pulsed MET, also known as the *Resistive duction* method, first described by the osteopathic physician TJ Ruddy in the 1960s. This simple method is very useful since it effectively accomplishes a number of changes at the same time, involving the local nerve supply, improved circulation and oxygenation of tissues, reduction of contraction, etc. I now use the term 'pulsed MET' to describe Ruddy's safe and effective method, which depends entirely for its success on the 'pulsed' efforts of the person producing them being very light indeed, with no 'wobble' or 'bounce', just the barest activation of the muscles involved.

AN EXAMPLE OF PULSED MET

- Sit at a table, rest your elbows on it and tilt your head forwards as far as it will go comfortably. Rest your hands against your forehead.
- Use a pulsing rhythm of pressure with your head, about two per second (as though bending it further forwards against your hands) of one-one, one-two; two-one, two-two; three-one, etc. until ten-two is reached.
- After 20 pulsations retest the range of forward bending of your neck. It should go much further, more easily than before. This method will have relaxed the muscles of the region, especially those involved in flexion, and will have produced 20 small reciprocal inhibition 'messages' to the muscles on the back of your neck which were preventing easy flexion.
- Variations may be used for all positions of movement of your head or any other part of your body. The simple rule is to engage the restriction barrier, provide a point of resistance (with your hands if possible) and to pulse towards the barrier rhythmically.
- If pain is felt, push less hard.

The pulsing method should always be against a fixed resistance, provided by your own (or a friend's) hands, just as in other MET methods. You can use the same positions outlined in the muscle energy chapters, for the various regions and

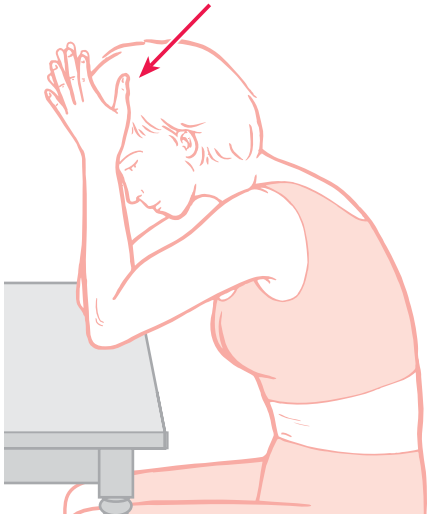

Figure 1.7 *The head and neck are flexed to their comfortable end of range and the hands offer resistance as the head is 'pulsed' 20–30 times, in the direction of resistance, against the firmly fixed hands. The pulsing contractions release the tight muscles at the back of the neck (by means of RI), allowing further movement into flexion afterwards*

muscles of the body, to create a starting position for pulsed MET usage, wherever a feeling of tightness or restriction is noted. The key to its successful use is to apply approximately 20 painless contractions, against resistance, in 10 seconds. This can be repeated several times or until tenderness and restriction ease.

Conclusion

The intensity, direction, duration and frequency of contraction are all important factors in successful application of muscle energy methods. Whether to use the affected muscles or their antagonists is the fundamental decision (pain will help to decide this). Breathing and eye movement are peripheral, but useful, refinements which can make the techniques more successful.

This, then, is the essence of muscle energy technique. It is simple and yet the rules are important, since too much effort or incorrect timing will negate the results.

Box 1.3 Explanations and summary of MET methods

WHAT IS AN ISOMETRIC CONTRACTION AND WHAT EFFECT DOES IT HAVE?
This is a light contraction in which the effort of the muscle, or group of muscles, is exactly matched by the counterpressure, so that no movement occurs, only effort. The effect of this is to create a period of relaxation of the muscle itself (postisometric relaxation) as well as of its antagonist (reciprocal inhibition) for about 20 seconds after the contraction, allowing stretching to be more easily accomplished.

WHAT IS PULSED MET?
A series of very small, rhythmically pulsing, isometric contractions toward the restriction barrier creates multiple reciprocal inhibition effects and usually allows an increase in range of movement. These pulsing methods can also be used to increase strength when used in previously weakened muscles.

WHAT IS A CONCENTRIC ISOTONIC CONTRACTION AND WHAT EFFECT DOES IT HAVE?
A concentric isotonic contraction is one in which the effort of the muscle, or group of muscles, is not quite matched by the counterpressure, allowing a degree of resisted movement to occur. This tones and strengthens the muscle itself.

WHAT IS AN ECCENTRIC ISOTONIC CONTRACTION AND WHAT EFFECT DOES IT HAVE?
An eccentric isotonic contraction is one in which the effort of the contracting muscle(s) is more than matched by the counterpressure, which therefore causes the contracting muscle(s) to be stretched as it contracts. If done slowly this tones the muscle itself while (temporarily) 'switching off' its antagonists.

WHAT IS AN ISOKINETIC CONTRACTION AND WHAT EFFECT DOES IT HAVE?
An isokinetic contraction involves the movement of a joint through a full range of motion, rapidly and using full muscle strength, against partial resistance. This is therefore a multiple isotonic movement, and has the effect of toning and strengthening all the muscles involved in the process.

HOW ARE DIFFERENT ISOMETRIC MET METHODS USED?
When the actual muscles which have shortened are contracted isometrically, then the phenomenon of postisometric relaxation will induce these shortened muscles to relax after the effort. When the antagonists are used in the contraction, the phenomenon of reciprocal inhibition will induce

Box continues

the shortened muscles to relax after the effort. Depending on whether the problem is acute or chronic, the short muscle may be gently taken to a new resting length without stretching (acute) or stretched (chronic), after the contraction.

WHICH MET METHOD SHOULD BE CHOSEN?

Either PIR or RI may be used although PIR is thought to be more effective (i.e. contracting the affected/shortened muscle itself). The only reason for choosing RI as a starting method would be because of pain or spasm in the affected muscle(s), when it is asked to contract. This would not always occur but if the pain is marked or there is spasm, then RI is suggested before or instead of PIR methods.

HOW DO THESE METHODS WORK?

Reciprocal inhibition obliges a muscle to relax because of the increased tone in its antagonist. This works through the mediation of the central nervous system (CNS) which tries to prevent the agonist muscle (the prime mover in any given movement) and its antagonist tightening at the same time (this would lead to movements such as occur in spastic conditions).

Postisometric relaxation, which occurs after an isometric contraction of a muscle, happens because of the activity of minute neural reporting stations called the Golgi tendon bodies. These lie near the origins and insertions of the muscles and report to the CNS the load the muscle is having to bear. An isometric contraction, maintained for some seconds, results in a report to the CNS asking for the muscle to be released and relaxed due to excessive load.

It is in the brief latent period of 20 seconds or so after an isometric contraction that the muscle can be stretched more easily than before the contraction. Both RI and PIR therefore result from application of physiological effects.

WHAT IS THE 'BARRIER'?

When a joint is restricted or a muscle shortened, thus reducing its range of motion, there will always be a direction in which movement is most limited. As the limit of movement, in that restricted direction, is reached, a 'point of bind' will be noticed, beyond which no more comfortable movement is possible.

When a *normal* joint is taken to its limit, it will usually be found that at the end of the range there is still a bit more movement available, a sort of springiness, in the joint. When there is *abnormal* restriction, however, the limit does not have this spring but rather, as with a jammed door or drawer, it is fixed at that point and any attempt to take it further is uncomfortable and the feel is distinctly of 'bind', blockage or jamming, rather than springiness. This is the barrier through which muscle energy methods will attempt to take the joint or area, by inducing relaxation in the muscles which are holding it fixed.

This 'endpoint', or barrier, can be described as having either a 'soft' or 'hard' end-feeling. Soft tissue restrictions always have a softer end-feel than internal joint restrictions which have a sudden or hard end-feel, especially when damaged by conditions such as arthritis.

HOW SHOULD THE ISOMETRIC EFFORT BE COMMENCED?

In acute conditions, having engaged the barrier (see below), the counterpressure is applied and the contraction commences, slowly.

There should be a build-up of muscular effort, coinciding with the counterpressure. The slow commencement of the effort prevents any jerking or sudden movement, which would ruin the strategy of inducing relaxation in the affected musculature. In chronic conditions, the contraction used is often stronger than that suggested in acute conditions and should start short of the barrier to reduce the slight chance of cramp.

HOW SHOULD THE ISOMETRIC EFFORT CEASE?

The same slow easing of effort is desirable at the end of the effort. After this a full breath is taken and sighed out slowly, as the muscles of the area involved are consciously relaxed. During the exhalation, in acute conditions, the tissues are taken to a new barrier, without stretch. In chronic situations a *very slight* stretch is made just beyond the restriction barrier, in order to introduce elasticity into fibrous, shortened

tissues. The stretch should be held for not less than 30 seconds for best results.

WHAT IS COUNTERPRESSURE?

Counterpressure is the force applied to an area which is designed to match exactly (isometric contraction) or partially (concentric isotonic contraction) or to overcome (eccentric isotonic contraction) the effort, or force, produced by the muscles of that area.

This counterpressure, or holding force, can be applied via the hand(s) of the person doing the exercise, someone else's hands, an immovable object against which pressure can be applied (furniture, wall, etc.) or against gravity, whichever is more appropriate.

HOW CAN GRAVITY BE USED AS COUNTERPRESSURE?

If you lie with a folded towel or pillow under your shoulders, your head will hang backwards, putting stretch onto the muscles on the front or side of your neck (if the head is turned). Gravity would be pulling the head towards the floor and the restraining muscles would be holding the head and would be under tension (see Fig. 1.8).

If you then slightly lift your head toward the ceiling, using the tense muscles, and hold this new position, then an isometric contraction would be taking place, in which the contracted muscle's effort would be matched precisely by the pull of gravity against it.

If this position is held for 5–10 seconds and then slowly released, these muscles would be affected by PIR; they would now be looser and could more easily be stretched by letting the head hang back to be supported by the surface on which you are lying.

This is an example of gravity-induced PIR and other examples will be found in the text.

HOW CAN AN IMMOVABLE OBJECT BE USED TO APPLY COUNTERPRESSURE?

If the muscles on the back of the thigh are shortened, it would be difficult to use your own hands, or gravity, to act as counterpressure to any contraction. This could be achieved by placing the heel of the outstretched leg onto a bench or stool, which serves as a resistance to an isometric contraction of the muscles of the back of the leg. Maintaining such a position for 7–10 seconds would produce PIR in the muscles, allowing them to be more easily stretched further after the isometric contraction, simply by leaning forward (see Fig. 1.9).

Figure 1.8 *The head is hanging down in order to allow gentle stretching of the anterior muscles of the neck, after an isometric contraction against gravity (CAUTION: avoid this position if dizziness is felt)*

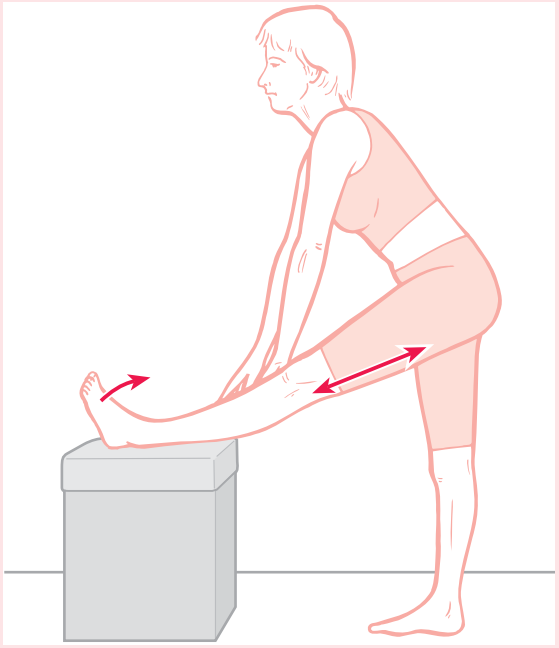

Figure 1.9 *Isometric contraction and stretch of hamstrings using PIR*

Box continues

HOW MUCH FORCE SHOULD BE GENERATED BY THE MUSCLES CONTRACTING WHEN ISOMETRIC AND OTHER MET METHODS ARE USED?

With most isometric contractions this should start at about 25% of the strength of the muscle for the first contraction. A subsequent contraction in chronic conditions (more than a month's duration) could involve greater degrees of effort but *never more* than about 40% of the available strength. Many experts use only about 10% of the available strength in muscles being treated for contractions, and increase effectiveness by employing longer periods of contraction. In acute conditions only light contractions are used, starting at the restriction barrier and moving to the new barrier afterwards, unlike the method applied to chronic conditions where the contraction starts just short of the barrier and stretches slightly through it afterwards.

In isotonic contractions greater effort may be employed, especially if isokinetic measures are involved, in which case full strength is used. In eccentric isotonic contractions an effort involving about half the full muscle strength is asked for.

Contractions and counterpressure should never become a struggle. Always maintain a controlled degree of effort in all such maneuvers.

HOW IS BREATHING USED IN MET PROCEDURES?

The use of coordinated breathing to enhance particular directions of muscular effort will be outlined where appropriate. Sometimes muscular effort is enhanced by inhaling as the effort is made, although this is not essential for successful application of MET. It is important when moving to a new barrier, or when starting stretching after a contraction, that full relaxation is achieved and this is often helped by breathing slowly and deeply, and by moving the area to its new position on an exhalation.

HOW LONG SHOULD THE MUSCLE ENERGY CONTRACTIONS LAST?

Isometric contractions should last 5–10 seconds. Isotonic and isokinetic contractions are usually accomplished in 4–7 seconds.

HOW OFTEN SHOULD CONTRACTIONS BE REPEATED AT ANY ONE SESSION?

Not less than two repeats of isometric contractions – more is not usually necessary. Concentric and eccentric isotonic contractions are often repeated several times depending on the effect needed. Isokinetic contractions are usually limited to two or three efforts at any one time.

HOW REGULARLY SHOULD MUSCLE ENERGY PROCEDURES BE USED?

In chronic cases regular employment of these methods is suggested until normalization, or no further improvement, is achieved. This could mean daily or on alternate days, for many weeks.

WHAT CONDITIONS CAN MET METHODS HELP?

Isometric contractions, those designed to induce both PIR and RI, are best used in treatment of muscular spasm, stiffness, contraction and shortening of muscles. They are also useful in loosening stiff joints, whatever the cause might be. However, the degree of improvement possible in such cases will depend upon the degree of actual joint damage.

PIR and RI are useful in preparing a joint for subsequent manipulation. Relaxing a previously shortened muscle so that it can reach its normal resting length is important in eliminating trigger points which lie in such muscles and which might be causing pain and other symptoms elsewhere in the body (see Chapter 4).

Isotonic concentric contractions, as well as slow eccentric isotonic stretches (SEIS), are used for toning weakened muscles.

Isokinetic contractions are used for toning weakened musculature and building strength in all the muscles involved in a particular joint's function.

ARE ALL JOINT PROBLEMS THE RESULT OF MUSCLE SHORTENING?

No, although if there are other reasons such as joint damage or cartilage or tendon injury, the muscles will be involved to some extent, since they are the prime movers of the bones.

Thus, even if there are causes other than muscle problems for a joint's stiffness, the application of MET methods will to some degree be helpful.

However, where muscles are the major cause, and this is in the majority of cases, the condition can often be normalized by MET alone.

HOW LONG DO THE PIR AND RI EFFECTS OF RELAXATION IN THE TIGHT MUSCLES LAST?

Tests have demonstrated that just one 7–10-second isometric contraction produced increases in the range of movement in joints of between 10% and 15%, which is still measurable some hours aftewards.

In practice it is found that, once relaxed, a tight muscle will not tighten up again unless provoked or irritated in some manner. If stretching is used following MET the muscle should maintain its new length, if the reasons for its shortness are not repeated (wrong use, strain, etc.).

It is suggested that normal use be resumed after muscle energy measures but that any violent or potentially irritating exercises be avoided for a few days. The beneficial effects should be permanent, if no reinjury is sustained.

SUMMARY OF PIR OR RI MET METHODS

1. Choose the type of MET method according to guidelines above.
2. Take the restricted area or joint to its comfortable limit, i.e. engage the barrier. In chronic conditions back off from the barrier before starting the contraction. In acute conditions start at the barrier.
3. Ensure the correct type and placement of counterpressure.
4. Commence contraction and counterpressure simultaneously. Never use more than 25% of strength unless otherwise instructed.
5. Hold the contraction and counterpressure for the appropriate time, which is usually 7–10 seconds.
6. Ease off both effort and counterpressure in a slow, coordinated manner.
7. Breathe in and sigh out slowly, as the muscles are consciously relaxed.
8. Slowly and carefully reengage the barrier to assess increased range of movement in acute conditions, whereas in chronic states go to a point just beyond the barrier to stretch the tight muscle(s). If possible, actively move the area into its stretched position. Hold the stretch for not less than 30 seconds.
9. Never, under any circumstances, forcibly stretch the shortened muscle(s) to the point where pain is produced (mild discomfort is acceptable), as this can produce a reflex reaction, contracting them again.
10. Repeat the whole process at least once more.
11. If no more improvement is noted, cease this type of MET and try the other (i.e. if PIR was used, now try RI or vice versa).
12. Variations in angle of effort can be used to involve a greater number of muscle fibers, with possible benefit.

SUMMARY OF CONCENTRIC ISOTONIC CONTRACTION

1. Place counterpressure hand(s) in position and contract the weak muscle, while the counterpressure just fails to control the movement so produced.
2. Although it is permissible to utilize the full force of the muscle involved in isotonic toning maneuvers, the start of the contraction should be a slow build-up of force, not a snatching jerk. The action should become one involving maximum muscle effort and the movement achieved should be slow, as the counterpressure allows movement to take place.
3. Effort and counterpressure should cease simultaneously.
4. Repeat three or four times.

SUMMARY OF ECCENTRIC ISOTONIC STRETCHING

1. The appropriate muscle is placed at maximum stretch and you should try to maintain this position as your other hand (or someone else's) attempts to overcome this and return the tissues to a neutral position.
2. Less than maximum effort is used (40–80% of strength), at the same time as the counterpressure is applied to slowly stretch the contracting muscle(s).
3. This may be repeated several times.

Box continues

SUMMARY OF ISOKINETIC CONTRACTION

1. Hold the affected joint (such as the ankle) with one or both hands.
2. Forcibly, and with maximum available effort of the muscles of the joint, attempt to move the joint through its full range of movements (flex, extend, rotate in each direction, etc.), whilst partially restricting this by counterpressure.
3. Only 3–4 seconds is needed at any one time for this to be effective.
4. Repeat several times.

These methods do not replace other types of self-help and should be combined with whatever else is helpful, whether this involves self-mobilization, exercise, self-massage or any other treatment. MET methods are very useful in preparing a joint for subsequent manipulation, making treatment easier and more effective.

MET techniques are very suitable for home therapy since little, if any, harm can ever come from their use, even when wrongly applied (except for excessive force being exerted). They should never cause pain and this should be a guide to their use. Pain means that too much effort or an inappropriate method of MET is being used.

These methods can be used daily or several times daily if helpful or only when necessary and can safely be employed where joints are damaged, as in arthritic conditions, because they do not involve movement of the joints and can therefore enhance the muscular status, either by releasing tight muscles or toning weak muscles.

There is no joint or muscle problem which cannot be helped, to some extent, by appropriate muscle energy technique and in many instances, where the causes involve strain or injury, the results are almost instantaneous and permanent. Spasm, contraction, tightness, stiffness and shortening of muscles represent major causes of pain and disability and MET methods can reduce this and lead to greater freedom of movement and relief of pain in many cases.