

## 12.2 The hand

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### INTRODUCTION

Hand dysfunction is commonly linked to ligamentous laxity (Murray 2006). The carpometacarpal joint (CMCJ) of the thumb may be particularly susceptible to weakened ligamentous constraints in the Ehlers-Danlos syndrome (Moore et al 1985). Symptoms may only present if the joint has been subject to excessive trauma, overuse or misuse and thus strains of the surrounding muscles and ligaments may have developed (Wynn Parry 2000).

In this chapter, assessment and treatment principles for the hypermobile hand will be discussed, including joint protection advice, energy conservation techniques, strengthening exercises, proprioceptive retraining and surgical principles. In particular, the impact of hypermobility in the hand is explored in relation to musicians, who are often hypermobile, and in relation to writing, which can also be significantly affected by the presence of hypermobility in both adults and children. Musical instrument modifications, writing retraining and the relationship between hypermobility and the development of osteoarthritis will be presented.

### ASSESSMENT OF THE HAND

If appropriate and safe to do so, hand therapy patients are routinely assessed for hypermobility utilizing the 9-point Beighton score (Chapter 1). Other relevant joints are assessed using passive and active range of motion measurements, and appropriately recorded utilizing the standardized goniometry guidelines established by the American Society of Hand Therapists. It is important not to limit the assessment to the joints examined in the Beighton Scale, since the patient may be hypermobile in other joints. The scale is not all-encompassing and should be used only as a guide to the level of hypermobility displayed by an individual.

Circumferential measurements of joints using finger tape measures that are provided by Jobst™ are taken as appropriate. The modified Oxford Scale of manual muscle testing (Kendall et al 1993) is used to assess relevant muscle groups and as a way of

assessing if the treatments are having an effect in increasing muscle strength and, in turn, joint stability. Maximal grip and pinch strength are measured using a hydraulic hand dynamometer and pinch meter, such as Jamar dynamometer and the pinch gauge by B&L Engineering (Mathiowetz 2002, Massy-Westropp et al 2004, Coldham et al 2006) and these again can map the patient's progress and provide feedback as to the tolerance to exercises and functional activities.

As mentioned previously, hypermobility may only be present in one specific joint, and not global, and thus careful assessment is required in order to fully ascertain the patient's symptoms and why the pain or functional difficulties are occurring. Assessment whilst performing functional tasks such as playing a musical instrument, writing or using cutlery is imperative, as hyperlaxity may be more evident whilst doing these activities (Fig. 12.2.1). It is important to distinguish between finger joint hyperextension, which can be a normal phenomenon, and lateral instability, which is often acquired or pathological (Tubiana 2000). Some level of hyperextension can be useful and assistive with certain task performance and the individual may have been born with a certain amount of hyperextension. If, however, the instability is acquired or pathological, the mechanisms and reasons why the phenomenon is occurring need to be analysed and addressed appropriately, in order to decrease progression of the condition.

### TREATMENT PRINCIPLES

Symptom management is the key factor in this patient group. Initially, treatment may focus on decreasing an acute episode of pain through resting the affected area. Splinting is particularly important in this respect. In time, treatment must focus on joint stability, muscle strengthening, sensorimotor retraining to improve proprioception and patient education regarding healthy joint use (Warrington 2003).

The assessment and treatment of symptoms and dysfunction in the hand due to hypermobility should be considered in the context of the whole



**Fig. 12.2.1** Assessment of hypermobility while handwriting

person. This will include attention to other areas of the body with symptoms, in particular the shoulder (Chapter 12.1) and cervical spine (Chapter 12.7), as well as considering postural alignment (Chapter 9) and general fitness (Chapter 13).

## JOINT PROTECTION AND ENERGY CONSERVATION

Whether or not hypermobility is the primary cause of symptoms, joint protection advice and energy conservation techniques are always provided to patients with this condition. There are specific exercises and many adaptive ways of performing tasks that can be helpful and easily incorporated into the patient's lifestyle.

These principles can be employed to preserve the patient's joints and reduce pain levels. They are a 'style of life' that once learned becomes second nature and rather than complicating life are designed to encourage independence.

Hand therapists can assist in giving advice about joint protection and energy conservation techniques. These principles have been modified from those utilized for patients with rheumatoid arthritis (Boxes 12.2.1 and 12.2.2).

## STRENGTHENING EXERCISES

Patients can benefit greatly from a rehabilitation programme to improve joint control, muscle power (Wynn Parry 2003) and stamina (Wynn Parry 2000). Initially, stability exercises include isometric muscle contraction in a pain-free range (with a support on if being used) to encourage co-

contraction of the muscles surrounding a joint. Involving the target object can be a useful progression to develop isometric strength and proprioceptive awareness, by maintaining the neutral joint position while holding a pen, violin bow or clarinet (Warrington 2003) and while performing the functional task. Later, exercises can be progressed to include concentric and eccentric strengthening.

The intrinsic and extrinsic muscles of the hand are frequently stressed in an attempt to compensate for joint instability (Brandfonbrener 1990). Therapeutic putty exercises can be useful for specific muscle strengthening and in turn joint stability. Intrinsic muscle strength is very important and, because these muscles fatigue quickly, short pain-free sessions of exercise are efficient and encouraged (Davis & Rogers 1998). It is imperative that the exercises are performed with slightly flexed joints, rather than collapsing into hypermobile positions (Fig. 12.2.2). The use of graded rubber bands to assist in strengthening the interossei and lumbricals of the hands is also recommended (Wynn Parry 1998).

Strength gains are slower in the hypermobile patient, possibly due to alterations in central and peripheral neuromuscular physiological processes. It may therefore take many months for stability and strength to improve enough for the patient to be able to perform the task in a modified way and so a graded return to task performance is often required (Simmonds & Keer 2007). A diary of writing retraining times or musical practice schedule may be necessary to monitor symptoms and tolerable time of task performance. Exercises must be continued until sufficient muscle strength has been gained so a neutral joint position can be maintained whilst performing the required task.

## PROPRIOCEPTIVE RETRAINING

Proprioception exercises and retraining, such as tapping exercises and weight-bearing exercises in a neutral position should be performed first with the eyes open and then with the eyes closed. After several months of performing strengthening exercises symptoms can improve and it is not uncommon to detect an improvement in ligament tautness with joint translation testing. It is encouraging for the hypermobile patient to be told that biomechanical dysfunction can be improved.

The product 3M™ Coban™ can be wrapped around a pencil, a bow of a stringed instrument,

**BOX 12.2.1 Methods of joint protection****1. Use joints in a good position**

Joints work best in certain positions. When they are used in the wrong position, such as when twisting, extra force is placed through the joint and the muscles are unable to work as well, eventually causing pain and deformity.

**2. Avoid activities that don't let you change the position of your hand**

When you are in a position for a long time your muscles get stiff and pull the joint into a bad position. The muscles also get tired quickly so the force is taken up by the joint and not the muscles, leading to pain and damage.

**3. Respect pain**

If pain continues for hours after an activity has stopped, this means that the activity was too much and should have been changed or stopped sooner.

**4. Avoid tight grips or gripping for long periods**

Gripping tightly may increase your pain. If you grip something that is small or narrow it can require greater power to hold and manipulate it. Some examples of how to decrease strain on joints include:

- Using thicker or padded pens for writing.
- Resting books on a table or book rest.
- Using a chopping board with spikes to secure vegetables.
- Using non-slip mats under bowls to hold them.
- Allowing hand washing to drip-dry rather than wringing it out.
- Relaxing your hands regularly during activities such as knitting or writing.

- Building up objects using foam tubing or special grip aids.
- Increasing the grip ability on a slippery object such as a shiny pen or toothbrush by using elastoplast or Coban tape.
- Many items have been ergonomically designed and can be purchased from supermarkets and department stores.

**5. Avoid activities that could lead to over-extension**

Some directions of force can lead to over-extension at the joints.

- Use a flat hand where possible such as when dusting or wiping.
- Try to use lightweight mugs with large handles rather than small teacups so pressure is not put on just one or two fingers.

**6. Use one large joint or many joints**

Stronger muscles protect large joints so it is better to use large joints where possible, or try to spread the force over many joints.

- Use the palms of your hands and not your fingers when you carry plates or dishes.
- When standing up from a chair, try to rock gently forward and use your leg muscles to stand up rather than pushing from your knuckles or wrists.
- Carry light bags from a strap on your shoulder rather than your hands.
- Use your bottom or hips to close drawers or move light chairs.
- Use your forearms to take the weight of objects when carrying, not your hands.

a stick of a drum or directly onto the finger to assist in retraining appropriate amounts of pressure applied when holding these items, and in turn facilitate an increase in proprioceptive awareness. This can lead to a decrease in the amount of muscle energy exerted to perform the task and thus fatigue and pain levels can be significantly decreased. Research performed by Lowell et al (2003) found that 3M™ Coban™ was effective in decreasing oedema in the skin-grafted burnt hand, and that this contributed to improved hand function, range of motion and strength levels with no impact on hand mobility, grip strength or function.

The use of a foam pad, lycra or silicon sleeve such as Silipos® can assist with proprioceptive retraining while performing a task such as playing a musical instrument (Fig. 12.2.3).

**SPLINTING**

Splints are a useful tool for supporting a joint in a neutral position to assist in decreasing joint strain and allow functional activities without pain. They are also thought to retrain proprioceptive awareness. Brandfonbrener (2003) comments that the use of ring splints for musicians with unstable

**BOX 12.2.2 Methods of energy conservation****1. Balance, rest and activity**

It is important to balance your rest and activity to allow your joints to rest and repair. Stop before you feel tired or are in pain and avoid activities that you cannot stop when you need to.

- Try to plan ahead. Write a weekly or daily diary with activities in red and rest times in blue. Think about what you need to do and space the harder activities out over time.
- Activities such as vacuuming, ironing and cleaning windows mean that you are doing the same movement lots of times and keeping the hand in the same position for long periods of time. Try to do them for very short periods, or where possible get someone else to do them for you.

**2. Organize and arrange space**

Prepare your work areas so that everything you need for that activity is there. Store items you use often in places that are easy to reach and keep things in small refillable containers, rather than large, heavy jars.

**3. Stop activities or parts of them**

- Use clothes that are easy to care for.
- Make the bed on one side and then the other.
- Soak dishes before washing them and let them drip dry.
- Where possible use tinned, frozen or prepared foods.
- Hang items within easy reach.
- Where possible get someone else to help with activities.

**4. Reduce the amount of weight you take through your joints**

- Consider wheeled trolleys rather than carrying things.
- Slide pans where possible and use a wire basket or slotted spoon to drain vegetables.
- When you buy new equipment, make sure it is lightweight.
- Use a teapot and/or kettle tipper and fill the kettle with a lightweight jug.

**5. Use equipment that reduces effort**

Automatic washing machines, frost-free freezers and food processors are all energy-saving devices and sharp knives enable less pressure and effort to be exerted.



**Fig. 12.2.2a, b Therapeutic putty exercises.** Exercising between extension (a) and relaxation (b) without allowing hyperextension to occur at the fingers and thumb



**Fig. 12.2.3** A Silipos® digital sleeve can be useful in decreasing the pressure exerted through a finger or thumb and in retraining positioning on the instrument

fingers caused by ligamentous laxity helps prevent hyperextension but also helps retrain proprioceptivity in how they position their fingers.

They may need to be worn for some time with a gradual reduction in their use as strength levels increase and symptoms decrease. There are a wide variety of splints that can be made individually for the patient and it may be appropriate to have one or more during the day, depending on the activity being performed, and a different splint when sleeping. Supports can include light thermoplastic splints, neoprene wraps, wrist braces, lycra finger sleeves or Coban™ wrap. There are also many pre-fabricated splints available which require assessment to ensure correct fit and functionality.

Hyperextension of the first metacarpal joint (MCPJ) is commonly observed in people with hypermobility, arthritis and in professionals such as musicians (Wynn Parry 2004) and hand therapists (Bozentka 2002). This may be due to decreased stability of the first carpometacarpal joint (CMC) and/or MCPJ (Alter et al 2002), which subsequently leads to degenerative changes. Butler and Svens (2005) present an alternative splint based on Van Lede's (2002) anti-swan neck splint for fingers, which restricts MCPJ extension of the thumb (Fig. 12.2.4). There are many other bespoke



**Fig. 12.2.4** A functional thumb metacarpal extension blocking splint (Butler & Svens 2005)

splinting options such as the (Galindo-Lim 2002), which allows for maximum functional use of the hand, stabilizes the MCPJ of the thumb and does not cross the wrist crease therefore allowing fairly full wrist motion.

## SURGICAL PRINCIPLES

There are a wide range of surgical procedures for the reconstruction of the osteoarthritic basal thumb joint: ligament reconstruction, hemiarthroplasty, trapezial resection with or without replacement and arthrodesis (Eaton & Glickel 1987). The option chosen depends on the pain experienced by the patient, the degree of hypermobility, the quality of the articular cartilage and the stiffness and degeneration in the trapezium. Radiographic evaluation of the trapezial articulations and open-mindedness when directly inspecting the articular surfaces at surgery influence the decision as to what procedure to apply to individual patients (Eaton & Glickel 1987).

Specific surgical stabilizing procedures for the unstable MCPJ should be considered, in order to increase levels of hand function, although Butler and Winspur (2009) conclude from their study of 130 professional musicians who underwent surgery, that conservative management and splinting achieve greater benefit than surgery in those with painful hypermobile joints.

## HYPERMOBILITY AND MUSICIANS

There is evidence to suggest that a higher incidence of hypermobility exists in musicians than in the population at large (Wynn Parry 2004). There remains debate as to whether this is an advantage or disadvantage for instrumentalists; an advantage in that it adds to the ability; a disadvantage in that injury may be more likely and take longer to resolve.

Increased range in the fingers, thumb and wrist may be an asset when playing repetitive motions on instruments such as the flute, violin or piano. Larsson et al (1993) found that 5% of musicians with hypermobility in their fingers and wrist joints presented with musculoskeletal problems, compared to 18% in those without hypermobility. Grahame (1993) showed a similar correlation and indeed, some very virtuosic players such as Paganini and Liszt were hypermobile.

However, Brandfonbrener (1990) consistently found a correlation between musicians with hand and arm pain and the presence of joint laxity. Jull (1994) and Hoppmann (1998) state that for many musicians hypermobility is an impediment and detrimental. Muscle weakness and increased vulnerability of the associated joint can lead to an increased propensity for the hypermobile musician to develop injuries or chronic 'overuse' syndromes. Ulnar nerve entrapment, known as cubital tunnel syndrome, is more likely in the musician with hypermobility of the elbow (Lambert 1992). Larsson et al (1993) concluded that hypermobility was a liability when the joints are required to be stabilizers, such as the knee or spine for timpanists who stand to play. In addition, there is evidence to suggest that hypermobile joints have a decreased sensitivity to proprioception (Chapter 6.4) so musicians may exert more force than necessary on keys or strings to provide greater security to that finger, thus increasing the possibility of chronic strain (Brandfonbrener 2003).

Particular attention must be paid to technique if the patient is hypermobile, with education, adaptive devices for the instrument and exercises to

strengthen the muscles of the hand and wrist being implemented (Patrone et al 1988). Success has been reported in treating the hypermobile musician for conditions such as synovitis (Bird & Wright 1981) and digital nerve compression (Patrone et al 1988, 1989).

## INSTRUMENT MODIFICATIONS

Many instruments can be modified to make playing them more comfortable and safer. Reducing the load to the musculoskeletal system can have an immediate beneficial effect. For example:

- The levers that operate the valves on the French horn can be lengthened and widened to provide greater leverage and increased contact area.
- Decreasing the load on the right thumb of a clarinet or oboe by using a splint (Fig. 12.2.5), a neck strap or a post that rests on the chest can alter right upper extremity loading (Hoppmann 2001).
- Adding an end pin to the cello relieves the player from supporting the instrument by grasping it with the legs. End pins have also been successfully employed in the bassoon, English horn and tuba. The end pin for the last two instruments has been modified into a ball that rests on the chair between the thighs. There are several devices on the market that relieve the right thumb strain so common to oboe and clarinet players (Markison 1993, Smutz et al 1995).
- The location of the flute keys can be customized to fit the player's hand. The cluster of keys worked by the right little finger can be angled inwards which reduces the strain between the fourth and fifth fingers. The keys operated by the left fourth and fifth fingers can be lengthened to achieve a more neutral left wrist position. A flute with a 'U' head can be useful for children.
- There are many adaptive devices and cases that have been specifically designed to decrease joint strain and distribute the load of the instrument. An example of a support is shown in Figure 12.2.5.

## HYPERMOBILITY AND WRITING

Finger hyperextension is commonly seen in patients with hypermobility of the upper limbs, and as a result handwriting is often affected. Prolonged

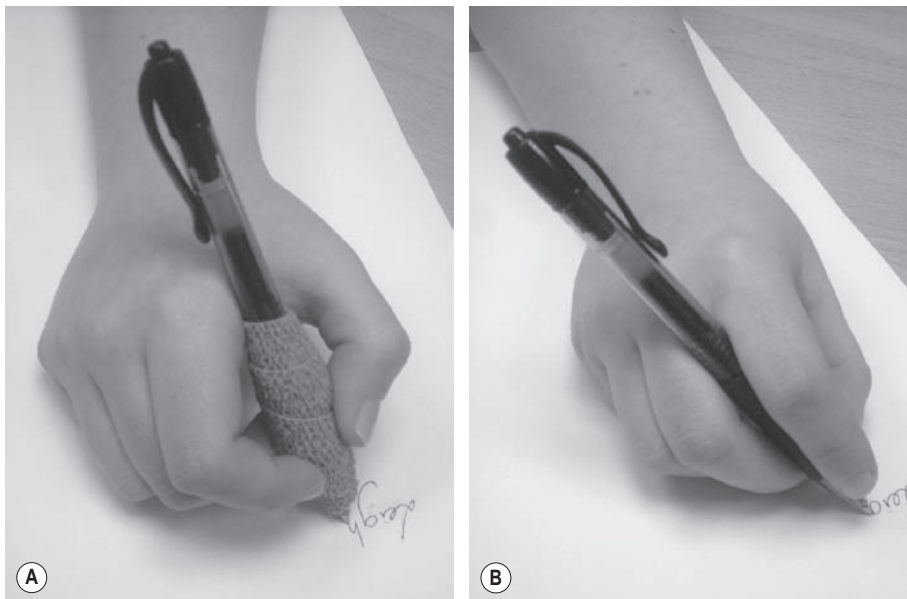


**Fig. 12.2.5** Right hand 'Bo-Pep' assisting the support of the left index finger and maintaining the MCPJ in a more neutral position

periods of writing can be fatiguing and painful, due to joint strain and muscle overactivity producing aches and cramp. Frequently, children have been told their handwriting is messy and may have been labelled as lazy or not interested in their work.

Assessing the patient as they write will give the clinician many clues as to whether a positional retraining splint, built up pen, writing aids (Davis & Rogers 1998) or strengthening exercises are the most appropriate treatment option. There are many adaptations to the pen and the pen hold that can be taught to reduce pressure and encourage larger movements of the wrist and elbow when writing (Fig. 12.2.6). It is also important that the individual supports the page with their other hand whilst writing, to decrease any pressure being exerted through the writing hand in order to hold the page in place. It is important that the chair, table and other equipment being used at school or home is considered so that the patient is able to position themselves optimally when writing (Murray 2006). Sloping writing surfaces and the use of a laptop computer may assist in increasing functional levels in this patient group.

Witt and Jäger (1984) present a case of a 26-year-old man whom they believe developed writer's cramp as a result of congenital subluxation of the first metacarpophalangeal joint. They comment that after a stabilizing procedure on the patient's



**Fig. 12.2.6** (a) Build up of the pen with Coban tape; (b) Adaptive pen hold between middle and index finger

thumb to eliminate the pathological hypermobile first metacarpophalangeal joint, hand function was normalized.

## OSTEOARTHRITIS

Some believe that hyperextension may be a risk factor for the evolution of osteoarthritis (Klemp & Learmonth 1984, Bridges et al 1992, Mikkelsen et al 1996, Jónsson et al 2009) whilst others do not support this view (Dolan et al 2003, Kraus et al 2004, Chen et al 2008).

Generalized ligamentous laxity has been seen for some time as a predisposing factor for development of idiopathic osteoarthritis of the trapeziometacarpal joint (Pelligrini 1991, Jónsson & Valtýsdóttir 1995, Jónsson et al 1996). It has been believed that hyperextension of the thumb metacarpophalangeal joint is secondary to degenerative subluxation of the trapeziometacarpal joint that occurs in osteoarthritis (Fig. 12.2.7).

Metacarpophalangeal joint flexion effectively unloads the palmar surfaces of the trapeziometacarpal joint, regardless of the presence or severity of arthritic disease in this joint. Moulton et al (2001) postulate that hyperextension laxity of the



**Fig. 12.2.7** Thumb MCPJ hyperextension when actively extending the thumb

metacarpophalangeal joint may identify individuals who are predisposed to development of osteoarthritis of the trapeziometacarpal joint, and that such individuals could benefit from intervention that assists in the stabilization of the MCPJ, thus reducing the progression of OA disease development at the base of the thumb. They also comment that in the symptomatic hypermobile MCPJ, fixation of this joint in flexion, by a splint or surgical stabilization, may decrease basal joint symptoms by redirecting trapeziometacarpal joint forces from the palmar compartment onto the healthier dorsal aspect of the joint.

A further study (Kraus et al 2004) assessed hypermobility and its relationship to radiographic hand OA in a family-based study. A total of 1043 individuals were enrolled into the study and the results showed no association of hypermobility and CMC OA, and indeed there was no evidence of increased chances of OA in any joint group of the hand due to associated articular hypermobility.

Rogers and Wilder (2007) present the effects of strength training among people with osteoarthritis. They set out to determine the effects of 2 years' whole-body strength training and grip exercises on hand strength, pain and functional levels in adults with radiographic evidence of hand OA. The results suggest that strength training increases both dynamic and static grip strength and decreases pain in older persons affected with OA.

## SUMMARY

The hypermobile patient provides the hand therapist with great challenges, many rewards and the possibility of developing new splintage and therapeutic techniques. Thorough assessment both while performing functional tasks and at rest is required in order to formulate an appropriate and assistive treatment programme. Symptoms must be managed, and splints can be a useful way to initially assist in decreasing pain levels. Joint stability must be the focus when treating this patient group, and exercises and functional task performance that enhances proprioceptive awareness and muscle strengthening are paramount. The patient's joints must be protected and often their lifestyles have to be modified in order to decrease joint degeneration or strain. Surgery is

not always the treatment of choice for this patient group; however, if it is required then it is imperative to select a surgeon with experience in treating patients with hypermobility. There are many

ways of modifying equipment and task performance in order to enhance independence and confidence and enable a more normal and less painful existence.

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