Joint protection and physical rehabilitation of the adult with hypermobility syndrome

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Purpose of review

Hypermobility and hypermobility syndrome are common conditions with universal interest. However, despite significant advances in our knowledge of the presentation and implications of lax tissues there is still much to learn about the best way to manage the symptoms. This review discusses our current knowledge on the management of joint problems associated with hypermobility syndrome.

Recent findings

Relieving joint pain and preventing its recurrence are primary aims of treatment and exercise to improve joint stability and control is a major component of physical rehabilitation. Research has identified that posture, proprioception, strength and motor control are important components in achieving this aim along with education, physical activity and fitness.

Summary

It is not yet known what form the optimal physical rehabilitation programme should take, but the components discussed here are based on sound scientific principles which it is hoped will further knowledge, stimulate interest and promote further research.

Keywords

hypermobile joints, hypermobility syndrome, joint protection, rehabilitation

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Introduction

Hypermobility is defined as an increase in the range of joint movement for an individual when age, sex and ethnic background are taken into consideration. It is greatest in women, in children (decreasing with age) and those of African or Asian descent [1]. This excessive range of movement is due to laxity in connective tissue, principally ligamentous tissue, which is inherited and determined by a person's connective tissue matrix protein genes [2]. In a clinical setting, joint hypermobility is most commonly measured using the Beighton nine-point scale [3] where a score of 4 or more out of 9 usually indicates generalized hypermobility (Table 1) [3,4].

Joint hypermobility does not necessarily cause problems and is thought to confer an advantage in the world of sport, dance and music, although there is evidence that connective tissue laxity can increase the risk of knee injury in contact sports [5]. Once musculoskeletal symptoms are associated with hypermobility (in the absence of any rheumatic, neurological, skeletal or metabolic diseases), a diagnosis of hypermobility syndrome or joint hypermobility syndrome (JHS) is made [6].

Joint hypermobility syndrome

JHS is a multisystemic condition in which joint pain is the primary complaint. A major component of the 1998 revised Brighton criteria used for diagnosing JHS [4] states that arthralgia is present for longer than 3 months in four or more joints in association with hypermobility (Beighton 4/9 or more) (Table 1). Pain most commonly affects the knees, spine, shoulders and feet (although any joint can be symptomatic) and is often related to the activities of the individual [7,8]. The tendency for hypermobile individuals to rest at the end of their joint range and to regularly use their joints in a 'locked' or end of range position is thought to be an attempt to improve stability [8,9]. This, combined with poor postural habits [10•,11•], dysfunctional movement patterns [11•] and defective proprioception [12] leads to stress and strain in the supporting structures of the joint, producing fatigue and pain. Pain inhibits use of the joint, producing weakness in the surrounding muscles. This leads to decreased control and stability, potentially causing further strain and exacerbating pain. Joint subluxation and dislocation can be a regular feature in some individuals. In addition, the passive supporting structures of

joints, such as ligaments, have a poor blood supply and injury may result in longer and poorer healing [13,14] and general deconditioning [15]. Some authors believe there may be a link between hypermobile joints and the development of osteoarthritis [16,17]. Treatment needs to break this vicious cycle to prevent descent into a downward spiral of declining function, loss of independence, self-esteem and self-efficacy [1].

Key points

- Although hypermobility syndrome is a complex multisystemic condition, joint laxity and pain are the primary complaints.
- Joint protection and injury prevention are key to managing symptoms.
- Optimizing joint stability and control throughout the full range of movement is a major component of physical rehabilitation.
- Rehabilitation should focus on the whole body and include specific motor-skill training to improve posture, joint control, proprioception and muscle strength.
- Physical rehabilitation, education on joint care and improving physical fitness allow the individual to self-manage the condition confidently.

Physical rehabilitation

Physical therapy is the mainstay of treatment and considered an effective form of management by consultant rheumatologists in the UK [18]. There are many facets to treatment of the hypermobility syndrome, but improving the health of the joints is a priority.

Initially, therapy aims to reduce pain and improve joint control and stability, progressing onto the ultimate aim of injury prevention and enabling the patient to self manage their condition confidently.

Joint control

The question of whether it is necessary or advantageous to restrict range of movement in hypermobile joints to protect them is unknown. Anecdotally it seems that hypermobile individuals complain of feelings of discomfort from stiffness and positively like stretching [19]. It is recommended that a normal range of joint movement for the individual is restored and maintained, but efficient and effective control is required throughout the whole range of movement and especially into the hypermobile range [11•,20].

Posture

The importance of good posture in physical wellbeing cannot be overstated. Kendall *et al.* [21] describe good posture as 'that state of muscular and skeletal balance which protects the supporting structures of the body against injury or progressive deformity' and where 'the muscles will function most efficiently'. It follows therefore that faulty posture will lead to 'increased strain on the supporting structures and . . . less efficient balance of the body over its base of support'. Suboptimal posture, both static and dynamic, is a common clinical finding in JHS individuals and recent research has suggested the trunk is most affected [10•]. An individually tailored posture re-education programme showed good improvement in pain and quality of life [10•].

Motor control

Improving trunk stability is often the starting point of a rehabilitation programme, because it is frequently found to be abnormal, and efficient trunk stability is required for effective peripheral joint stability. Patients with recurrent low back pain have been shown to have an altered postural strategy whereby activation of the deep postural (stability) muscles, which support the spine against perturbation, is delayed. These findings have also been found to occur in pain-free individuals who anticipated (experimental) pain on movement [22] and this mechanism, mediated by the central nervous system (CNS), could be a factor in fear avoidance or kinesiophobia shown in JHS patients [1]. In addition, it has been shown that patients with musculoskeletal pain have functional changes in the representation of affected muscles on the somatosensory cortex and that these cortical neuroplastic changes can be reversed by motor-skill training [23••].

The excellent review by Boudreau *et al.* [23••] suggests several key components to maximize rehabilitative success. Exercises or motor training should target a specific component of movement which requires greater skill and precision. It should be pain-free, as pain rapidly alters the excitability of the motor cortex and contributes to protective motor control strategies and so hinders learning. It should be goal-orientated or 'cognitive' to enhance cortical changes and focused on quality rather than quantity to prevent fatigue and pain interfering with improvements in task performance.

Research has shown that specific, isolated, low level, skilled stabilization training leads to an improvement in timing of activation of postural muscles to near normal levels and is better than non-isolated functional exercise [24–26]. In addition, changes can occur after one session [25], lead to cortical reorganization showing motor learning [26,27], and can be transferred to functional activities [24] which are still maintained at 6 months [28].

The first randomized controlled trial (RCT) in physiotherapy, looking at treating hypermobility in children, has shown that while both a generalized and targeted physiotherapy exercise programme achieved significant

Table 1 Criteria for diagnosing joint hypermobility and joint hypermobility syndrome

Nine-point Beighton Hypermobility Score [3]
A point is scored for each side of the body in manoeuvres 1–4 below, with one point for manoeuvre 5, giving a possible total of 9 points if all manoeuvres are positive

1. The ability to passively extend the 5th metacarpophalangeal joint to $\geq 90^{\circ}$
2. The ability to passively appose the thumb to the volar aspect of the forearm
3. The ability to passively hyperextend the elbow to $\geq 10^{\circ}$
4. The ability to passively hyperextend the knee to $\geq 10^{\circ}$
5. The ability to actively place the hands flat on the floor without bending the knees

The Revised Diagnostic Criteria for the Joint Hypermobility Syndrome (JHS) [4]
JHS is diagnosed in the presence of two major criteria or one major and two minor criteria or four minor criteria. Two minor criteria will suffice where there is unequivocally affected first-degree relative. JHS is excluded by the presence of Ehlers–Danlos syndromes (other than the EDS hypermobility type formerly EDS III) or Marfan syndrome

Major criteria
1. A Beighton score of 4/9 or greater (either currently or historically)
2. Arthralgia for longer than 3 months in four or more joints

Minor criteria
1. A Beighton score of 1, 2, or 3/9 (0, 1, 2, 3 if aged 50+)
2. Arthralgia in one to three joints or back pain or spondylosis, spondylolysis, spondylolisthesis
3. Dislocation in more than one joint, or in one joint on more than one occasion.
4. Three or more soft tissue lesions (e.g. epicondylitis, tenosynovitis, bursitis)
5. Marfanoid habitus (tall, slim, span height, upper segment: lower segment ratio <0.89, arachnodactyly)
6. Skin striae, hyperextensibility, thin skin or abnormal scarring
7. Eye signs: drooping eyelids or myopia or antimongoloid slant
8. Varicose veins or hernia or uterine/rectal prolapse

improvements in pain scores, at the 3-month follow-up, the parental assessment of improvement in pain was significantly in favour of the targeted programme [29•] and suggests additional benefits that are in agreement with clinical experience [8,9,14].

Muscle strengthening

Individuals often present for treatment in a physically deconditioned state, which is thought to be a result of reduced physical activity due to longstanding pain from recurrent injury or postural misuse [30••]. Muscle weakness is a common clinical finding, particularly in the presence of pain, and has been found to occur in the knee extensors and to a lesser degree in the knee flexors of adults [31] and in children [32] with JHS. Interestingly, another study [33] showed no significant difference in muscle strength at the knee between women with and without joint hypermobility, but this may be explained by a lack of symptoms in the latter study. The women did, however, show a higher rate of force development in the knee extensors, thought to be important for fast joint stabilization, which may be a future consideration in both treatment and research.

Proprioception/kinaesthesia

Normal movement relies on a complex integration of proprioception, kinaesthesia and motor control. Proprioception is defined as the ability to sense joint position and movement in order to ensure joints are correctly positioned and have suitable muscle tone for the activity [12]. It is known that JHS individuals have a deficit in proprioceptive acuity of the finger joints in terms of position sense [34] and the knee joint in terms of kinaesthesia or movement awareness [12,32,35]. It is not clear which part of the proprioceptive mechanism might be at fault. However, Ferrell *et al.* [36] found segmental musculoskeletal reflexes were impaired, in particular the quadriceps reflex, in JHS patients. In almost half of the patients it was absent, whereas in others, when present, it was found to progressively reduce in amplitude into hyperextension, in contrast to nonhypermobile individuals. This may have important implications for stability around the knee, and be part of the explanation for the common sensation of the knee 'giving way' [37••].

Rombaut *et al.* [38•] confirmed similar deficits in knee joint position sense in patients with Ehlers–Danlos syndrome (EDS) type III (hypermobility type), considered by leading authorities in the field to be synonymous with JHS [39•], but no difference in vibratory perception sense. In addition, rather interestingly, no significant difference was found in joint position sense at the shoulder joint between the EDS type III group and the control group and this finding has been confirmed by other researchers [40]. These are new areas which have not been reported on before in this client group and

further research is indicated to verify and explore the implications.

Exercise programmes, designed to enhance proprioception and so improve joint stability, have been shown to be successful. Keays *et al.* [41] showed a positive effect on motor function in anterior cruciate ligament deficient knees following a 6-week preoperative exercise programme to such an extent it was suggested that the improved stability may, in certain cases, avoid the need for surgery. The parameters that showed significant improvement were quadriceps muscle strength, balance and unexpectedly, but of potential importance for JHS, increased passive stability at the knee. In JHS patients, a 6-week exercise programme designed to improve joint stability demonstrated a significant decrease in global pain and reduced hyperlaxity at the knee [42] and, more recently, a similar programme over 8 weeks [35] showed a significant reduction in pain scores, enhancement of proprioception and improvements in function. More specifically, Ferrell *et al.* [36,43] demonstrated significant improvement in proprioceptive acuity, balance and muscle, as well as improvement in pain and quality of life following an 8-week programme of progressive closed chain kinetic exercises. Strikingly, the segmental reflex, absent in almost half of the JHS patients prior to the programme, was elicited following the programme [36]. This change in reflex function is thought to be due to improved motor neurone activation at a spinal level and suggests plasticity in the spinal circuitry [37••].

Recent landmark work [44] has emphasized the importance of skin in proprioception and kinaesthetic sense. Because of skin laxity, often present in individuals with JHS, we recommend enhancing sensory input via the skin through 'hands on' movement facilitation, the wearing of tight fitting clothing and neoprene gloves and the application of tape during specific exercise or functional rehabilitation sessions. Tape has been shown to have a beneficial effect on pain [45,46], mechanical stability [47], joint laxity [48,49] and proprioception, but only in those with a deficit [50,51]. Rhythmical stabilizations are a useful method to improve postural stability both globally and more specifically around a joint [52]. Weight-bearing and closed kinetic chain exercises, such as standing on one leg, mini squats, single-leg knee bend and four-point kneeling, are recommended to enhance proprioceptive feedback [42,43] and can be progressed on to more dynamic balance activities using a balance (wobble) board, foam rollers and the Swiss ball [8,30••]. Open chain exercises are included in the middle and later stages of rehabilitation to be more functionally specific.

Education

Education on joint care forms an important part of an overall management programme where the emphasis is on educating and empowering the patient to avoid harmful postures and activities which can overstretch and strain hypermobile joints [14,53,54]. Butler [55] recommends joint care and energy conservation techniques which have been modified from those utilized for patients with rheumatoid arthritis (RA) and two RCTs have found greater benefit in terms of pain, fatigue, functional ability and self-efficacy when a joint care programme for RA was based on behavioural methods rather than a standard information based programme [56,57]. As poor proprioception is linked to hypermobile joints, it is essential that advice includes individualized skills training, exercise practice with feedback, problem-solving and attention to personal beliefs in order to motivate the individual to change behaviour.

External support

As a rule, splints and braces are discouraged in favour of strengthening muscles to support joints effectively, but there are situations when selected use can be advantageous. Bespoke or off the shelf supports can be used to support tissues during the acute phase of an injury to facilitate the recovery phase [11•] and during specific activities to prevent injury [58]. The key factor in their successful use is thought to be in providing psychological support and reducing fear [59]. Splints which stabilize the joints yet allow good function are particularly recommended in the hand [55] and provide additional benefit when combined with a joint protection programme and exercise in osteoarthritis [60]. Sensible footwear with a strong heel counter, robust fastenings and cushioning materials are recommended to provide support for the hypermobile foot with some individuals requiring functional foot insoles or orthotics [61].

Physical activity and physical fitness

Once efficient and effective joint control has been achieved, individuals with JHS are encouraged to develop a lifelong commitment to physical activity to maintain good health and wellbeing [30••]. The effects of exercise can be short lived once exercising stops [42] although there is some evidence that once efficient muscle activation has been hard wired into the brain and used automatically in everyday activities, changes are retained for up to 6 months [28]. Decreased sports activity is frequently a feature in JHS [38•] which will impact on the physical health and wellbeing of an individual. The challenge then is to find activities and sports which are safe, enjoyable and maintain good cardiovascular fitness. Exercise in water has been recommended [38•] and could include swimming (good technique is essential to prevent strain of the cervical and lumbar spine) or deep water walking or running using a buoyancy belt [30••]. T'ai Chi has been shown to improve muscle activation and stability while standing [62]. Pilates and some forms of yoga and dance are also recommended [30••], but for

some, perhaps the most exciting news is the recent finding that balance and lower limb strength is significantly improved by exercising on the Wii Fit [63] although caution is required in order to prevent 'Wiiitis' [64].

Additional features

While this article has focused on joint protection measures in order to alleviate the joint symptoms associated with JHS, it is to be remembered that there are frequently other features of the disorder to consider. There is evidence of dysmotility producing gastro-intestinal symptoms [65,66], autonomic dysfunction [67,68], carpal tunnel syndrome [69], chronic regional pain syndrome (CRPS) [70] and chronic pain [1,71], which may necessitate referral to different specialists for assessment and treatment. While exercise in various different forms will play a part in the treatment of these additional complaints, those individuals with life dominating pain may require a psychological input using cognitive behavioural therapy and a pain management programme [72].

Conclusion

JHS is a complex multisystemic condition with joint laxity and pain as the primary complaint. Joint protection and injury prevention form a major component of a successful rehabilitation programme. These aims are achieved through improving posture, joint stability and control through specific motor-skill training which includes pain-free, cognitive exercise to enhance proprioception and muscle strength. Renewed confidence in the joints will lead to resumption of a more normal level of physical activity with the benefits of improved physical fitness and wellbeing.

There are still many unanswered questions and clearly further research is necessary to try to discover the optimal form of rehabilitation to maintain joint health in JHS.

Acknowledgements

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