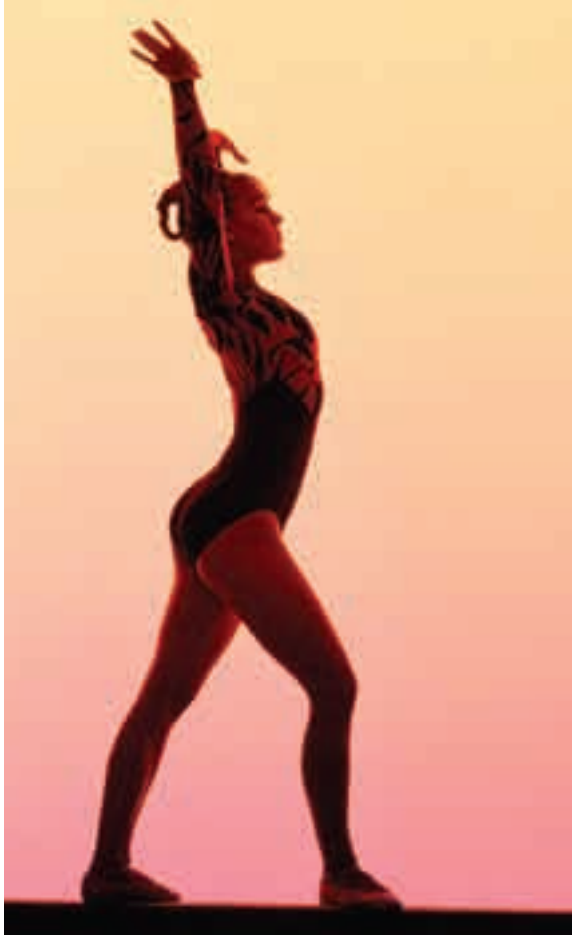
Spine injuries in rhythmic gymnastics



APA Sports Physiotherapist Kate Roberts—MHSc (Sports Physio), BAppSc (Appl Science)—takes a look at spinal injuries and the injury management of rhythmic gymnasts.

Rhythmic gymnastics (RG) is a sport that combines the beauty and elegance of classical ballet with the strength and fitness of artistic gymnastics. Rhythmic gymnasts demonstrate extreme levels of flexibility and strength in performing their body work while also perfecting handling of several different apparatus (rope, hoop, ball, ribbon or clubs).There is little research specifically on rhythmic gymnastics, as most research has involved artistic gymnastics. However, we are able to apply statistics relating to classical ballet to RG as they are very similar in their biomechanics and fundamental components.

Technical demands

Different rhythmic standards, techniques trained, hours of practice and competition demands will affect each gymnast differently, but some common technique faults predispose the gymnast to injury. To assess these technique issues, it is necessary to understand the biomechanics of dance and in particular classical ballet, as many of the skills performed in a rhythmic gymnast's routine are derived from ballet.

Turnout is fundamental to rhythmic gymnastics; 180 degrees of turnout is desirable and 60–70 degrees of hip external rotation is required to achieve this safely. Adequate hip turnout is required to achieve full hip abduction to the extremes desired as well as for aesthetic reasons as it creates a better line in body work such as attitudes and arabesques. Leg extensions in arabesques, attitudes and grande battements are desired to be well above 90 degrees. Side flexions and penchees must be performed with greater than 180 degrees between the two legs with the body held at 90 degrees to the top leg, while split leaps are also required to be performed achieving greater than 180 degrees between the two legs. Great levels of flexibility of the hips and spine are required to achieve any of these positions successfully. Balances in

any of these positions must also be held for more than three seconds, which requires considerable strength at the end of joint range.

Spine injuries

Some of the most common injuries of the rhythmic gymnast affect the lumbar spine, with incidence reports ranging from 10 to 37% of all injuries. One study from the USA found that 86% of RG participants reported low back pain. A recent New Zealand study found that 50% of injuries are classified as acute and 50% as overuse or chronic. They found that injuries to the spine are more commonly chronic or overuse injuries, and statistics are therefore underestimated as gymnasts frequently fail to report chronic pain as an injury. Thoracic injuries are relatively uncommon and rarely reported in research, with cervical spine injuries reported even less frequently.

At the Rhythmic Gymnastics National Competition level, lumbar spine and thoracolumbar injuries are some of the most common injuries reported. Between 2002 and 2006, 21.4% of injuries treated were acute and 51.4% were chronic. Of all the injuries requiring treatment, 39% affected the lumbar spine or thoracolumbar region and of those injuries, 24% were acute and 56% were chronic.

The repeated extreme hyperflexion and hyperextension required for RG is associated with most of the lumbar spine disorders seen. Lumbar disc bulges are rare and it is more common to see facet joint dysfunctions. Spondylolysis and spondylolisthesis are also more common in rhythmic gymnasts than the normal population, with spondylolysis affecting approximately 8% of the normal population but up to 20% of rhythmic gymnasts. Excessive loading of the thoracolumbar junction, thoracic stiffness and facet joint pathology as well as lower rib dysfunction and sacroiliac joint dysfunction are also associated with the thoracic hypokyphotic and lumbar hypolordotic posture commonly seen in rhythmic gymnasts.

Apophysites of the spine have recently been reported in young athletes and epiphysites have also been reported in adolescents, although not specifically related to gymnastics or sport. Stress reactions and stress fractures of the pars interarticularis and kissing spine are also more commonly found in gymnasts than the average population, with 70% of stress fractures occurring in late adolescence. Stress reactions and stress fractures occur typically in normal bone that is subjected to repeated loading and have been found to be closely associated with repetitive or incorrect technique.

Scolioses often develop just prior to and during puberty. There is a 10-fold higher incidence of scoliosis in gymnasts compared with controls, which has been suggested to be due to their increased ligament laxity, dysmenorrhoea and asymmetrical loading of gymnastics training. Rhythmic gymnasts are often more flexible than the average population and have greater passive joint range than active joint range, which results in joint instability and is associated with increased risk of injury. Increased laxity of the ligaments results in poor proprioception and therefore decreased stability of joints from mid to end of range positions. Increased laxity may lead to multi directional instability of many joints including the zygapophyseal joints leading to impingement syndromes, especially in the younger gymnast. This poor joint stability combined with the typical posture of a rhythmic gymnast also leads to poor hip/lumbar spine dissociation and sacroiliac joint problems.

The female athlete triad (disordered eating, dysmenorrhoea and osteoporosis) has been reported in up to 78% of female rhythmic gymnasts. It is desired that elite rhythmic gymnasts have 5–10% body fat and one study found that they tend to consume only 80% of daily energy requirements. Dysmenorrhoea is associated with an increased risk of injury (such as bone stress), decreases in performance and decreases in wellbeing. Muscle strains are usually acute and are often associated with inadequate warm up or fatigue at the end of training, while muscle cramps are caused by dehydration, electrolyte imbalances, fatigue and excessive practice of a new skill.

RG has been shown to be a very asymmetric sport, with skills practised and performed on the stronger side with far greater repetition than the weaker side. Gymnasts also tend to focus on stretching their more flexible side, and this leads to significant muscle imbalances and overloading of the spine. To achieve perfection and reproducibility of their performance, skills must be practised over and over again which puts the gymnast, and particularly their spine, at risk of overuse injuries. Gymnasts have a high pain tolerance and train with some degree of discomfort on a daily basis, often failing to recognise the difference between pain from fatigue and pain from overuse, resulting in chronic overuse injuries. Acute injuries, however, often occur at the beginning of training because of inadequate warm up, inappropriate progression of skills, more complex skills being practised early when the gymnast is ‘fresh’ and late in training due to fatigue.

Common technique faults

Forcing turnout, tucking under the pelvis, uncontrolled lumbar extension and asymmetric stretching/training are the most common technique faults in RG.

Forcing turnout by placing the feet at 180 degrees on the floor and screwing the knees to achieve rotation increases the lumbar lordosis and this causes a tightening of the thoracolumbar fascia, erector spinae and iliopsoas muscles. The experienced gymnast will overcorrect by posteriorly tilting the pelvis to create a flat back, which compresses the intervertebral discs, facet joints and sacroiliac joint as well as increasing thoracic stiffness and altering muscle mechanics. This results in psoas insufficiency syndrome where initially the iliopsoas becomes short and tight and in more skilled gymnasts it becomes overstretched and weak. A gymnast compensates for lack of hip external rotation and tight iliopsoas by hyperextending and rotating the lumbar spine in arabesque and attitude derriere (behind), or by dropping the pelvis to increase leg height en avant (in front). This increases the torsional stress on the lumbar structures and sacroiliac joint. It has been reported that up to 45% of lumbar pain in dancers is due to keeping the back too straight in arabesque and 25% is due to hitching the hip to create external rotation.

Common muscle imbalances seen in rhythmic gymnasts include low hamstrings to quadriceps strength ratio, poor eccentric hamstring control with overactive hip flexors, poor gluteal strength with weak/tight piriformis, tight hip external rotators with weak internal rotators, weak transverses abdominus with tight lumbar extensors as well as long, weak iliopsoas or tight overactive iliopsoas. A recent Sydney study found that 14 year olds dancing more than eight hours a week had an increased risk of developing chronic injury. Many gymnasts train up to five hours a day, five or six days a week well before 14 years of age! These gymnasts start competing in earnest as young as nine years old and face intense levels of competition as they reach puberty. During periods of growth, they will experience increased muscle tightness, decreased epiphyseal strength and decreased motor coordination.

Injury management

Injury management should be multifaceted, requiring a specialised approach to diagnosis and treatment. It is important to consider structural and functional implications, psychological influences, impact of working conditions, whether the injury is acute or chronic and whether the dysfunction is primary or secondary. Some standard tests will also need to be modified such as the straight leg raise, as rhythmic gymnasts often have 180 degrees of passive hip flexion.

Rhythmic gymnasts tend to be ectomorphs—they have a long skeleton and long, lean limbs which means they have to control a longer lever arm when performing, and this requires a very high level of core control to minimise injuries. Rhythmic gymnasts also tend to be very goal oriented and highly motivated which will impact diagnosis and rehabilitation.

Rhythmic gymnasts' flexibility has been found to be highly correlated with successful performance; however, a recent study found that stretching prior to performance actually decreased muscle strength and jump height. Between the ages of eight and 16, passive flexibility/joint ROM does not change, which means that increases in dynamic flexibility are due to increases in strength at the end of range. It is therefore wise not to stretch to improve flexibility on the day of competition and to stretch at the end of training rather than at the beginning. Technique and proprioception training should be emphasised to increase control to develop specific strength through range and stability at end range. It is important to remember that most rhythmic gymnasts are children—their physical and mental health is very important and they can't follow an adult program. Prior to puberty, it is better to work on agility and skills and, as pre-pubescent muscles have a greater proportion of Type II fibres than Type I fibres, to focus on slow, controlled low load movements.

Injury prevention is better than treatment and correction of technique faults is paramount to treatment. Exercises must be as specific as possible so it helps to have some knowledge of skills and bodywork. Periodic screening to monitor weight, uncover pathology and detect any musculoskeletal imbalances will allow rhythmic gymnasts to correct technique issues to prevent injuries.

Presently, most rhythmic training programs emphasise flexibility at the expense of through range strength (control/proprioception) and fitness. A team approach to treatment should therefore emphasise strength, flexibility and fitness. Fitness training for 30 minutes twice a week at a HR of 70–80% MHR has been found to improve pain management, decrease the risk of injury and increase wellbeing in dancers and gymnasts.

Kate Roberts