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.

Apophysitis 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, dysmenorrhea
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, dysmenorrhea
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.
Dysmenorrhea 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 transversus 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/proprpoiception) 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.

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