CHAPTER 04

Knowledge Review

Q1: Why is the study of biomechanics so important to the sports therapist?

A1:

Being able to assess the musculo-skeletal [biomechanical] system is crucial to providing sports therapy. Biomechanics is the study of the posture, movement and physical functioning of the body. Physical or biomechanical assessment for sports therapy follows on from the initial consultation, and takes place providing there are no particular concerns or contra-indications to the client's participation. It provides the therapist with the necessary information in order to offer the best advice, treatment and exercise. If no assessment is performed, then the therapist cannot proceed safe in the knowledge that both they and the client are aware of the current presenting situation, nor can goals and objectives be properly set. In the main, physical assessment for sports therapy is based upon accepted orthopaedic principles of examination and is largely musculo-skeletal in focus. Once completed, the therapist should review, discuss and agree with the client, achievable objectives in light of the assessment findings. The physical assessment is only of use if it is performed accurately and reliably. Accepted techniques should be used to ensure validity, and the practitioner should take care to perform tests in the correct manner and record test results.

Q2: What is meant by the following terms: i] diagnosis; ii] prognosis; iii] sign; iv] symptom; v] somatype.

A2:

i] diagnosis: the definite nature of the presenting problem; a considered opinion based upon a series of assessment methods.

ii] prognosis: the probable duration, progress and outcome of the presenting problem.

iii] sign: an objective, physical finding that can be felt, heard or seen by the therapist during assessment [eg. bleeding; swelling; malalignment].

iv] symptom: a subjective finding provided by the subject relating to their perception of the problem [eg. numbness; shooting pain; cold].

v] somatype: the very basic categorization of a person's body type [soma means body]: ectomorph; mesomorph; endomorph.

Q3: List 10 items of equipment used by the sports therapist for physical assessment.

A3:

1. Consultation form
2. Physical assessment form
3. Height measure scale
4. Calibrated weight scales
5. Tape measure
6. Goniometer / flexometer
7. Dynamometer
8. Sphygmomanometer / Blood pressure monitor

9. Stethoscope
10. Plumb-line
11. Reflex hammer
12. Couch
13. Exercise mat
14. Large [full height] mirror
15. Wall grid
16. Camera
17. Camcorder
18. Anthropometer
19. Computer with biomechanical software
20. Isokinetic dynamometer
21. Treadmill

Q4: What are the basic objectives of a physical assessment?

A4:

1. To assess acute and post-acute injuries and chronic problems.
2. To assess postural problems.
3. To assess gait efficiency and identify problems.
4. To identify musculo-skeletal imbalances.
5. To measure major joint RoM, and compare against accepted norms and identify hyper or hypomobility.
6. To assess muscle integrity, nerve supply and functional strength and flexibility.
7. To help identify problematic tissues.

8. To develop client awareness and understanding of how the body is put together, how muscles and joints work, and what is ideal for them.
9. To help the therapist formulate achievable objectives for the client.
10. To recommend specific action [sports therapy treatment; exercise; orthotic device].
11. To present specific relevant information to other health-care practitioners.
12. To provide a starting point to treatment.
13. To help improve sporting performance and reduce the potential for injury.
14. To help improve functional performance [movement; gait; breathing; circulation; appearance].
15. To monitor the client's progress and improvements when continuing on a programme of treatment and exercise.

Q5: What techniques are commonly employed by the sports therapist during physical assessment?

A5:

1. Discussion of medical history, current problems and objectives.
2. Explanation of the proposed procedures to follow.
3. Observation of body language, body type, postural alignments, body contours, muscle tone, RoM, gait, functional activities [activities of daily living: ADL's], and comparison of other, adjacent and contra-lateral body parts.

4. Palpation of tissues [skin; fascia; muscles; tendons; ligaments; bones; joints; bursae; organs; glands].
5. Measurement of height, weight, posture, RoM, strength, body circumferences, body fat, leg lengths, lung function.
6. Performance of special tests. These include: neurological tests [sensations; reflexes; reactions]; ligament stress tests; circulatory tests [heart rate; pulses; blood pressure]; regional integrity tests [for specific muscles and joints].
7. Inspection of footwear and sporting equipment.

Q6: Describe BMI and WHR, and discuss the positives and negatives of each.

A6:

BMI [Body Mass Index] is a commonly used estimate of obesity. The simple formula takes the individual's weight [in kg] and divides this by their height [in m] squared. The resulting figure is then compared against a small scale of generalized norms. Although a better indicator of obesity than weight alone, as it also takes into account the individual's height, the BMI formula does not make allowances for very muscular individuals [whose greater proportionate weight can be due to the fact that muscle tissue is heavier than fat], nor for the elderly with low muscle mass [where their BMI could be underestimated, and may appear to be inappropriately normal].

The WHR [Waist to Hip circumference Ratio] helps to identify patterns of fat distribution in the upper and lower body. Waist circumference, measured just

above the iliac crests across the umbilicus in centimetres, is divided by hip circumference, measured at the widest point just above the level of the greater trochanters. A WHR score of >0.8 for females and >0.9 for males is considered as a risk factor for coronary heart disease. The WHR score is prone to invalidity by the therapist's poor skill in technique, by inappropriate equipment or by client factors.

A high BMI or WHR score is generally considered as a risk factor for CHD, hypertension, respiratory problems, musculo-skeletal disorders, metabolic disease [such as adult-onset diabetes] and other health related problems, and is usually a reason to pursue other assessments and lifestyle evaluation.

Q7: Why is careful palpation such an important skill for the sports therapist to develop?

A7:

Palpation is the act of assessing tissues through feel or touch. It helps the therapist to monitor the effects of applied techniques and further develop his or her understanding of the presenting condition. Palpation of tissues, during initial assessment adds crucial diagnostic information to what the client has told the therapist. It should be performed systematically, so as to include all appropriate tissues, and it is obviously combined with close observation or inspection of the tissues. Palpation normally begins at a distance to a problem area, and gradually and carefully works its way in, both in terms of proximity and depth. Palpation allows the therapist to localize pain and tenderness to specific tissues, to identify temperature changes and the presence of fibrosis

or trigger points. The therapist should be careful to try and identify the problematic tissues and the severity of the problem without causing undue discomfort to the client or aggravation of the problem. It is important to remember that there is often more than one tissue injured during any incident, and that palpation is a technique to be performed carefully.

Q8: List 10 possible causes of postural problems.

A8:

1. Congenital deformities [which are not always known]
2. Injury
3. Physical defects [eg. poor eyesight or hearing can cause habitual postural tilting]
4. Sedentary lifestyle [can lead to muscle atrophy and low resistance to gravity]
5. Inappropriate or excessive exercise [can lead to muscle imbalance, eg. excessive resistance work to the chest muscles can lead to rounding of the shoulders]
6. Lack of flexibility training [can lead to chronic shortening of certain muscles]
7. Occupation [repetitive work can lead to muscle imbalance]
8. Poor ergonomics [ergonomics is the assessment of the efficiency of the individual to their working or resting positions, and the resultant optimisation of work stations, equipment and furniture]
9. Disease and degenerative processes [eg. arthritis, osteoporosis, asthma, neurological disorders]

10. Lengthy periods of illness or recovery from surgery [can lead to muscle atrophy and weakness]
11. Emotional disturbance [eg. depression, low self-esteem, stress, worry or anxiety]
12. Inappropriate clothing [eg. high heels; tight shoes]
13. Certain sports [eg. gymnasts can be prone to lordotic postures and hypermobility]
14. Pregnancy [postural changes occur during the middle stage of pregnancy, particularly stresses to the lumbo-sacral region]
15. Being overweight [additional stresses are placed upon the weight-bearing bones and joints and restricted RoM can occur]
16. Being tall [this can cause the individual to develop a forward head and kyphosis of the thoracic region]
17. Chronic fatigue and weakness
18. Poor nutrition [eating disorders or a nutrient depleted diet can lead to a variety of musculo-skeletal problems]
19. Poor body awareness and postural habits generally when sitting, standing, walking, carrying, lifting, pulling, etc.
20. Failure to consult a therapist when problems begin to manifest [and to take appropriate action]

Q9: Describe the ideal plumb alignment in the lateral, posterior and anterior views.

A9:

Head and neck

- The lateral plumb-line should travel through the ear down to the acromion process
- The posterior plumb-line travels midway through the occiput and cervical spinous processes
- The anterior plumb-line travels midway through the head and face

Shoulder

- The lateral plumb-line should pass through the acromion process and head of the humerus
- The posterior plumb-line should fall midway between the scapulae
- The anterior plumb-line travels midway down through the neck to the manubrium of the sternum

Thoracic region

- The lateral plumb-line should travel midway through the upper trunk
- The posterior plumb-line should travel through the thoracic spinous processes
- The anterior plumb-line should travel through the sternum and xiphoid process

Lumbar region

- The lateral plumb-line should travel midway through the trunk
- The posterior plumb-line should travel through the lumbar spinous processes
- The anterior plumb-line should travel midway through the middle of the torso

Pelvis and hip

- The lateral plumb-line should travel just anterior to the sacro-iliac joint and through the greater trochanter
- The posterior plumb-line travels through the middle of the sacrum and gluteal cleft [as the iliac crests, gluteal folds and greater trochanters are seen to be level]
- The anterior plumb-line should travel midway through the pelvis [pubic symphasis]

Knee

- The lateral plumb-line travels slightly anterior to the middle of the knee
- The posterior plumb-line should be midway between the knees
- The anterior plumb-line should be midway between the knees

Ankle and foot

- The lateral plumb-line travels just anterior to the lateral malleolus
- The posterior plumb-line should be midway between the medial malleoli
- The anterior plumb-line should be midway between the medial malleoli

Q10: List 10 common postural deviations.

A10:

1. Forward head
2. Excessive cervical lordosis
3. Flattened or reduced lordotic cervical curve

4. Head tilt
5. Head rotated
6. Clavicle asymmetry
7. Rounded [forward] shoulders
8. Dropped or elevated shoulder
9. Medial rotation of shoulder
10. Lateral rotation of shoulder
11. Cubitus valgus
12. Cubitus varus
13. Cubitus recurvatus
14. Adducted scapulae
15. Abducted scapulae
16. Winging scapula[e]
17. Kyphosis
18. Funnel chest [pectus excavatum]
19. Barrel chest
20. Pigeon chest [pectus carinatum]
21. Scoliosis
22. Lordosis
23. Swayback
24. Flat back
25. Anterior pelvic tilt
26. Posterior pelvic tilt
27. Lateral pelvic tilt
28. Pelvic rotation

29. Coxa valga
30. Coxa vara
31. Hip [femoral] anteversion
32. Hip [femoral] retroversion
33. Genu varus [bow legs]
34. Genu valgus [knock-knees]
35. Genu recurvatum
36. Patella alta
37. Patella baja
38. Internal tibial torsion
39. External tibial torsion
40. Tibial valgus
41. Tibial varus
42. Pes planus [flat foot]
43. Pes cavus [high arch]
44. Hindfoot / rearfoot valgus [valgus heels]
45. Hindfoot / rearfoot varus [varus heels]
46. Forefoot valgus
47. Forefoot varus
48. Hallux valgus
49. Hallux rigidus
50. Splay foot
51. Claw toes
52. Hammertoes
53. Plantar flexed first ray

Q11: Describe the correct principles for assessing ranges of movement at joints.

A11:

The sports therapist needs to have knowledge of what is the normal range of movement [RoM] at each major joint or region, as this provides a general guide to assessment. It is also important to develop awareness of which particular movements are normally available at each major joint [flexion, extension, rotation, etc.], When assessing clients it is important to allow a few degrees discrepancy either side of the stated norms, especially if they are present bilaterally. Issues such as pain, arthritic changes, subluxation, muscle spasm, hypertonicity, or swelling must be taken into consideration. The therapist should try to refine their skill in assessing tensions, restrictions and qualities presented at joints at the end-range of passive movements [keeping aware of the *ease-bind* concept and the quality of *end-feel*]. Observation and measurement, combined with palpation and client feedback, provides the main relevant information regarding assessment of joint movement. Hypermobility should also be assessed, as this can be potentially problematic. Where excessive joint motion is noted the number degrees beyond normal should be recorded. Ranges of movement are commonly measured with a goniometer or a tape measure. A goniometer is useful for measuring joint ranges of movement, as well as particular structural angles of the body, for example the carrying angle of the elbow and the Q angle of the knee.

Most sagittal plane measurements have the goniometer aligned to the lateral side of the joint. Frontal plane movements are measured anteriorly or posteriorly. Transverse plane measurements are usually taken superiorly or inferiorly. The therapist should explain procedure to client. They should also estimate the expected RoM prior to measurement. The movement being measured should be performed [passively or actively] carefully once or twice. The therapist should try to view the goniometer at eye level, and the goniometer must be aligned correctly. Any limitations to the starting positions should be recorded, and the body should be stabilized from unwanted movements. The therapist should record whether the measurement was an active or passive movement, and any particular information relating to the quality of movement and end-feel. Using the correct techniques each time ensures that results are reliable and valid.

Sometimes it is appropriate to record a range of movement in terms of centimeters. The thoracic and lumbar regions are often assessed as a combined functional unit. Tape measurements are taken from specific bony landmarks before and after movement.

Q12: Describe the normal gait sequence.

A12:

STANCE PHASE	**SWING PHASE**
[60% of total gait, at normal walking speed]	[40% of total gait, at normal walking speed]

Contact [Heel-strike] Initial contact with the ground **Midstance** [Foot-flat] Single-leg support, with body directly over weight-bearing leg **Propulsion** [Toe-off] Pushing off from the ground	**Acceleration** [Initial swing] The limb begins to advance **Swing through** [Mid-swing] The non-weight-bearing limb is advanced to where it passes directly underneath the body **Deceleration** [Terminal swing] Controlled slowing of swing in preparation for heel-strike contact

Q13: What are manual muscle tests, and what information can they provide?

A13:

Manual muscle tests are tests where the subject performs active contractions of specific muscle groups against the therapist's [manual] resistance, typically with the tested muscles placed in a mid-range position. Both isometric and isotonic contractions can be assessed. The contractions may be held for upto 5 seconds, and possibly repeated a few times to determine the degree of weakening. Knowledge of the main myotomes helps when assessing for neurological impairments relating to the muscles. Any weakness or atrophy

discovered in the muscles of a particular myotome can be an indication of a problem at the associated spinal segment. Muscle testing also provides other useful diagnostic information, such as whether or not the subject reports pain on resisted contraction. The strength of contraction can be graded using a simple scale, such as: 0 for no contraction [zero]; 1 for slight contraction [poor]; 3 for weak contraction [fair]; 4 for normal contraction [good]; 5 for strong contraction [very good]. During these tests the involved muscle group will ideally be palpated and observed at the same time. The therapist should always compare the involved muscle groups with their contra-lateral counterparts. Whereas manual muscle tests assess the contractile tissues [muscles], ligament stress tests assess the inert [non-contractile] tissues [ligaments] and therefore, these two types of test help the sports therapist to differentiate between muscles and ligaments when assessing common soft-tissue injury problems.

Q14: Explain how ligaments are assessed.

A14:

Ligament stress tests involve the sports therapist placing a longitudinal stress along the length of a ligament. Ligaments are non-contractile, supportive and relatively taut and strong connective tissues, which stabilize joints and attach to adjacent articulating bones. When a joint is forcibly impacted, twisted or stretched, beyond its normal positioning ligaments can be torn. Like muscle strains, ligament sprains are classified as being minor partial tearing [1st degree], more severe partial tearing [2nd degree] or complete rupture [3rd degree]. It is common for a ligament injury to result in swelling and bruising,

and for functional movements to become very painful. There may be an associated dislocation or subluxation, and often other structures are injured during the same incident [eg. muscles or tendons; cartilage; bone; nerves]. During a ligament stress test, the therapist is looking for excessive laxity of the joint or a painful response from the subject. Obviously, other tests are necessarily performed in conjunction, such as careful palpation around the joint and especially over the insertion sites of the affected ligaments.

Q15: Why can basic neurological tests be useful in physical assessment for sports therapy?

A15:

There are a selection of neurological tests that the sports therapist should be familiar with. Myotome testing is assessment of the major muscles, relative to their motor nerve supply, and can provide information which helps the therapist distinguish between a muscle injury and a nerve injury. Dermatomes are specific strips of skin supplied by spinal sensory nerve roots, and each dermatome region of the body relates to a specific spinal segment. Aching and pain, paraesthesia [pins and needles] or anaesthesia [numbness] in a particular dermatome, are all possible symptoms of a problematic nerve supply. Deep tendon reflexes relate to specific spinal segments and the involved sensory and motor fibres. Reflex testing involves tapping a particular tendon briskly [but not too hard] with a reflex hammer and observing the quality of the reflex. The reflexes are taken on both sides of the body and compared. They are graded as being absent, diminished, normal or exaggerated. An abnormal reflex helps the therapist to localize any impairments. Lower motor neurons, when impaired, tend to diminish their associated reflexes. Upper motor neurons, when dysfunctional, tend to exaggerate their reflexes. It must be remembered that some people have diminished or exaggerated reflexes normally, and that younger and older people tend to show reduced responses.