CHAPTER-I

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Sports injuries are injuries that happen when playing sports or exercising. Some are from accidents; others can result from poor training practices or improper equipment. Some people get injured when they are not in proper condition. Not warming up or stretching enough before you play or exercise can also lead to injuries. The most common sports injuries are sprains and strains, back injuries, knee injuries, swollen muscles, Achilles tendon injuries, pain along the shin bone, fractures and dislocations. Low back pain is a most common problem among young athletes. These individuals are at risk for significant structural injuries or nonmedical problems that can be associated with their symptoms. Any athlete who has severe, persisting, or activity-limiting symptoms must be evaluated thoroughly. Clinicians must have a working knowledge of developmental issue, injury patterns and particular conditions that may affect a given athlete and be able to work with patients in addition to families, coaches, trainers and other involved in the care and training of the injured athlete. (Christopher, 2008)

PAIN AND ACUTE INJURY

While inflammation is often the most visible aspect of an acute injury, from the athlete's perspective, pain is often the biggest immediate problem. It is important to remember that while everyone copes with pain differently, and further pain is as much as psychological as it is physiological. As a physiological phenomenon, pain is essentially the result of sensory input revived through the nervous system that indicates the location of the damage. When damage occurs to tissues the result is an alteration of the normal homeostasis of the structures involved. It is the process of altered homeostasis that triggers the pain response resulting in sensory nerve receptors transmitting to the central nervous system. When pain is the result of external forces, impulses travel on relatively slow nerve fibers known as nociceptive C fibers. These fibers are labeled as slow because their conducting velocity is comparably slower than other afferent nerve fibers, such as those for the sense of touch and temperature. The nociceptive fibers are slower because of tow primary factors; first they are smaller in diameter than other afferent nerves, thus limiting the volume of unlike most nerve cells, they have little or no fat in their bodies. It is the fat, known as mylination that is responsible for substantially increasing conduction velocities of resultant stimuli. (Sharma, 2006)
The speed of nerve conduction is important and plays a primary role in effective treatment of pain. As afferent messages are sent to the CNS they are "ranked" based on the number of impulses received per unit of time. As such, massage with the highest velocities receives priority status by the CNS. For example, if a pain message and a touch message reach the CNS simultaneously, the touch message is given higher priority. This can be demonstrated by noting that more often than not, when a person suffers a blow, such as hitting one's head on something, the first reaction is to rub the area. The process of rubbing the injured area stimulates the fast velocity touch receptors, thus blocking the pain signals. This explanation of pain is based on the gate control theory of pain, which was first developed in the 1960s and published in the journal Science. The gate control theory of pain is only one possible explanation of the pain process and it should be noted that research continues regarding our understanding of pain. Sports medicine personnel can use a variety of modalities to treat pain associated with injury. Perhaps as important as understanding the precise mechanisms of pain is understanding how each athlete responds to pain. Pain has been defined as "the perception or an uncomfortable stimulus or is the presentation or response to that stimulus by the individual." As such, it must be remembered that each individual responds to pain differently. It is essential to the process of the initial evaluation of an injury to be familiar with the athlete's typical response to pain. (Sharma, 2006)

An athlete with an extremely high pain tolerance may underestimate severity of an injury and conversely, an athlete with low pain tolerance may grossly exaggerate the severity of an injury. In essence, pain may not be a useful indicator of the severity of an injury. When a coach must a decision about the significance of an injury, it is doubt, refer the athlete to medical personnel. Pain may also be thought of as the athlete's friend, in that it serves as a mechanism to reduce the athlete's activity level until adequate tissue healing has occurred. It is critical to remember that the treatment of pain should be the domain of sports should not treat the pain associated with an injury to enable an athlete to return to participation. (Sharma, 2006)

PAIN

The sensation of pain originates in free nerve endings which end blindly between the tissue cells. These pain receptors are present in most tissues, but are especially numerous in the skin. Pain is a mechanism to alert us to injury so that we can react appropriately. Different types of pain that may be experienced include acute pain caused by fracture, aching pain caused by chronic inflammation, continuous pain such as heartburn, pounding pain such as vascular
compromise, referred pain caused by nerve entrapment, and burning pain. The type of pain can be a pointer to the correct diagnosis. The most common types encountered in sport injuries are acute pain, and the chronic, dull ache experienced following activity or during the night due to chronic inflammatory problems. Pain can often be effectively treated with medication, but it will not go away until its cause has been removed. Back pain is interpreted as a warning sign of tissue injury should lead to modification of activity or resting the injured tissue. The athlete who has sustained a muscle injury should not participate in competition until no pain is experienced during strenuous training. (Finebury J, Nodular S & Kreveckors, 1997)

TYPES AND THEORIES OF PAIN

Types of Pain

Pain is useful; it can prevent injury, educate, help recovery and warn us against certain behaviours. There are rare cases of congenital analgesia (where the person never suffers pain) and this is a severe handicap. But pain is puzzling. It is hard to define. It can be chronic if it is experienced continuously over many months or acute if it is relatively short lived. If its physical cause is known it may be described as organic if not it may be psychogenic. We now realise that there are probably physical and psychological components to most pain.

There are also some strange experiences which people may have related to pain. For example episodic analgesia where people suffer no pain at the time of the injury, but it comes later. And there is phantom limb pain where an amputated limb continues to hurt. (Melzack & wall, 1962)
Beecher illustrated the importance of perception. He compared the experience of pain in WW2 soldiers with later civilian men who had undergone surgery. He found that although the wounds were similar in both groups, 49% of the soldiers claimed to be in moderate or severe pain compared to 75% of the civilians. 32% of the soldiers requested medication as against 83% of the civilians. Beecher interpreted this in terms of the meaning of the pain. (Beecher & Henry, 1965)

Theories of Pain

a) Specificity theory: This traditional approach (von Frey 1895) argues that there is a special system of nerves which carries messages from pain receptors in the skin to a pain centre in the brain. One of the points in favour of this approach was the discovery that there are specialised receptors in the skin for different sensations like heat and touch. The problem with this approach, as Melzack and Wall point out, is that it doesn’t explain psychological pain, e.g. phantom limb pain. A further problem has been revealed by recent technology which allows us to record the activity of specific nerves but they do not match pain specifically. (Melzack & Wall, 1965)

b) Pattern theory: Unlike specificity theory, pattern theory suggests that there are no separate systems for receiving pain, but instead the nerves are shared with other senses like touch. The most important feature of pain is the pattern of activity in the nervous system. So, too much stimulation (e.g. too much touch) will cause pain.

c) Gate Control theory: This is the dominant theory today. It is a bio psychosocial theory which combines the medical approaches of previous theories with the psychological and social factors that contribute to pain. It contradicts pattern theory by stating that there are separate nerves for pain and touch and those different receptor fibres perform different functions. (Melzack & Wall, 1965)

Gate control theory

Broadly it states that there is a gate mechanism in the spinal cord which controls the passage of messages about pain. The degree to which the gate is open or closed is affected by the messages coming from pain fibres at the site of the damage but also by messages coming from pain fibres and from the brain. Hence rubbing a damaged area stimulates other peripheral fibres and helps reduce the experience of pain. Also knowledge, beliefs and past experience affect perception of the pain. Melzack and Wall describe how American soldiers injured in 2WW
denied that they felt any pain from their extensive wounds – they were so relieved at escaping alive from the battlefield that they perceived their injuries as positive, and this attitude caused the gate to close. (Melzack & Wall, 1965)

Gate opened or closed by 3 factors:

1. Activity in the pain fibers - opens the gate
2. Activity in other sensory nerves - closes the gate
3. Messages from the brain - concentrating on the pain or trying not to think about it

Some factors are known to open the gate and some to close it

Table-1.1 - Gate control theory; Conditions that open or close the gate

<table>
<thead>
<tr>
<th>Conditions that open the gate</th>
<th>Conditions that close the gate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical conditions</td>
<td></td>
</tr>
<tr>
<td>Extent of the injury</td>
<td>Medication</td>
</tr>
<tr>
<td>Inappropriate activity level</td>
<td>Counter stimulation, e.g. massage</td>
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<tr>
<td>Emotional Conditions</td>
<td></td>
</tr>
<tr>
<td>Anxiety or worry</td>
<td>Positive emotions</td>
</tr>
<tr>
<td>Tension</td>
<td>Relaxation</td>
</tr>
<tr>
<td>Depression</td>
<td>Rest</td>
</tr>
<tr>
<td>Mental conditions</td>
<td></td>
</tr>
<tr>
<td>Focusing on the pain</td>
<td>Intense concentration or distraction</td>
</tr>
<tr>
<td>Boredom</td>
<td>Involvement and interest in life activities</td>
</tr>
</tbody>
</table>

Painful impulses from the pain receptors only reach the brain if the "gate" is open. (Melzack & Wall, 1965)

Three variables control this gate

1. A-Delta fibers (sharp pain)
2. C fibers (dull pain)
3. A-Beta fibers that carry messages of light touch
Special neurons located in the grey matter of the spinal cord make up the gate. This gate has the ability to block the signals from the a-delta and c-delta fibers preventing them from reaching the brain. The special neurons in the spinal cord are inhibitory i.e. they keep the gate closed. These special neurons make a pain blocking agent called encephalin. This is an opiate substance similar to heroin which can block Substance P the neurotransmitter from the C fibers and the A-delta fibers and this keeps the gate closed. C-Fibers and A-Delta fibers obstruct (inhibitory) the special gate neurons and tend to open the gate. A-beta fibers are irritable (excitatory) to the special gate neurons and tend to keep the gate closed. If impulses in the C and A-Delta Fibers are stronger than the A-beta Fibers the gate opens. A-delta fibers are always stronger. Specialized nerve impulses arise in the brain itself and travel down the spinal cord to influence the gate. This is called the central control trigger and it can send both obstructive and irritable messages to the gate sensitizing it to either C or A-beta fibers. e.g. if the central control sensitizes the gate to C fibers it is more likely to open. If it sensitizes to A-Beta fibers it is more likely to close. (Turk & Rudy, 1985)

Hence cognitive processors influence the transmission of pain.

**Cognitive processors that open the gate:**

Anxiety - Tension - Depression e.g. persons having surgery - focusing on pain.

**Cognitive processors that close the gate**

Happiness- Optimism- Distraction - Concentration e.g. footballer, soldiers.

In summary whether or not pain impulses are received by the brain is dependent on a combination of the following

1. The strength of the C fiber impulses (opening the gate)
2. The strength of the A-beta fiber impulses (closing the gate)
3. The central control trigger’s sensitization of the gate to C or A-beta Fibers (to either open or close the gate) E.g. rubbing area after a bump reduces the pain by stimulating the a-beta fibers of
Back injury

Lower back pain is particularly common in young fast bowlers. Previous research has reported that these injuries occur in up to 60% of cricket players. The reason for such a high incidence of back injury has been attributed to a combination of factors. These include inadequate physical and physiological preparation, relatively reduced bone density following a ‘growth spurt’, postural defects, biomechanical aspects of the bowling technique, rapid escalation in training frequency, duration of bowling spells in matches, and the repetitive nature of movements. (McGrath & Finch, 1996)

Low back pain

Backache or back pain is a common symptom and affects up to 85% of individuals in their lifetime (Back Pain). In most cases (80%), there is no clear diagnosis or anatomic finding to account for the pain. By contrast to general back pain, low back pain often has specific causes: 70% of cases by simple strains and sprains; 10% by age-related changes; 4% by disc herniations; another 4% by compression fractures from osteoporosis; and 3% from narrowing (stenosis) around the spinal nerve roots. (Hills, 2009)

- Low back pain can occur in connection with most sports, and its precise cause is unknown.
- The symptoms often appear after lifting a heavy object or turning rapidly, but can also occur without previous exertion.
- The pain is usually located in the lower back and does not radiate down into the legs.
- Stiffness occurs in the back.
- The posture may appear asymmetrical, with the back bent to one side as a result of muscle spasm inhibiting the movements of the back that trigger pain. (Keen JS, Albert MG, Springer SL, Drummond D & Clancy WG, 1989)
McCaffery & Pasero, (1999) conducted that Stress fracture of the lumbar spine is a common injury in young fast bowlers. Fast bowling in cricket requires a combination of spinal hyperextension (bending back) together with rotation and side flexion of the trunk. This puts a lot of stress on an area of the vertebra called the 'Pars Interarticularis' and this is where stress fractures develop.

![Figure I.B- Anatomy of sacrum](image)

Lower back stress fractures are usually characterized by an ache in the lower back which is exacerbated by sporting activities and eased by rest, although a small percentage of people with a stress fracture can be pain free. Typically it is sore when the patient bends backwards, particularly if standing on one leg. If a lower back stress fracture is suspected, a doctor may decide to refer the patient for a scan to confirm the diagnosis. Pharmacological therapies often do not provide adequate pain relief and may have side effect with long-term use. Use of a nonpharmacological adjuvant, such as reflexology may increase pain control and minimize the untoward effect of analgesics. (Hanks-Bell, Halvey, & Paice, 2004)

**The Game of Cricket**

Cricket is a game played between two competing teams of eleven players each, on a large expanse of ground called a pitch. In the centre of the pitch is a length of hardened flattened grass, called 'the wicket'. At each end of the wicket are placed three sticks adjacent to each other in an upright position, these are known as the 'stumps'. The stumps are separated by a gap not greater
than the diameter of a cricket ball. On top of each set of stumps are placed two smaller sticks, or 'bails'. (Van der Hoeven & Kibler, 2006)

Cricket originated in England and is popular mainly in areas that formerly made up the British Empire, including England, Australia, India, Pakistan, Sri Lanka, Bangladesh, South Africa, New Zealand, Zimbabwe and the West Indies. (Van der Hoeven & Kibler, 2006)

At any time in a cricket match there are two batsmen from one team (the batting team) on the pitch and 11 players from the opposing team (the fielding team) on the field. Designated players from the fielding side, called bowlers, have the task of projecting a hard leather-covered ball towards the batsman. Each bowler has six consecutive attempts at bowling a cricket ball at the batsman. These six attempts constitute one over in the game. (Stretch, 1993)

The bowler’s aim is to dismiss the batsman by: Bowling the ball in such a manner that the ball strikes the wickets, either directly or indirectly off the batsman. Bowling in a manner which forces the batsman to hit the ball into the air so that it can be caught by a fielder before it strikes the ground.

The aim of the batsman is to score as many “Runs” as possible before he is dismissed. Runs can be scored in a number of ways: each time that the batting pair runs between the wickets after a ball has been bowled, a run is scored. If the ball travels outside of the playing area, after having touched the ground prior to leaving the playing area, then four runs are scored. If the ball does not touch the ground on its way out of the playing area, six runs are scored. (Van der Hoeven & Kibler, 2006)

When a batsman is dismissed, he is then replaced by the next batsman in the team’s line-up. Once ten batsmen are dismissed, it brings to an end the batting side’s innings. The total runs scored by all batsmen in the team constitute the score for that innings. The side which fielded first will then go in to bat for an innings. The team who has scored the most runs at the end of both innings wins the match. (Van der Hoeven & Kibler, 2006)

The length of Cricket games can vary in duration of time, and the number of balls bowled. In a "Test" match each side has two innings to bat and bowl. At the end of both teams' innings the side which has scored the most runs in both innings wins. Test matches are played over a period of five days. In "Limited Overs" Cricket, however, each side has only one innings and the duration of the match is fixed so as to complete the game in a day. The number of balls
the batting side faces in its innings is limited usually to 50 overs. These matches are also called "One Day Matches". (Van der Hoeven & Kibler, 2006)

**Action or Indoor Cricket**

This form of cricket is played in a large indoor arena between two teams of eight players each. This form of cricket is more popular among younger individuals between the ages of 16-26. (Dennis, Finch, & Farhart, 2005)

The pitch in indoor cricket is same length as a conventional cricket pitch. The indoor playing area is completely enclosed by tight netting, which is approximately two meters from each side of the indoor pitch. This tight protective netting comprises the “walls” of the playing area. In action cricket each innings consists of 16 overs, with each player having to bowl two overs and bat in a partnership for four overs. Other differences from conventional cricket include:

1) Artificial grass matting is the playing surface.
2) The scoring and other rules may differ from conventional cricket.
3) A modified cricket ball with a softer centre is used.

**Cricket bowling**

**Bowling Speed:** Cricket bowlers are usually classified as being slow, medium paced or fast bowlers. Fast bowlers bowl at speeds of 130 km/h while medium pace bowling speeds range between 110-130 km/h and slow bowlers bowl at speeds between 86-110 km/h (Lewis, 1992). These values may not apply to Action Cricket bowlers as there are differences in the run-up length, the playing surface and ball used. Sood (2007) stated that a fast bowler in Action Cricket may bowl between 85-125 km.h⁻¹ or more according to Thomas, 2007 (Dennis, Finch, & Farhart, 2005)

**Stages of the Bowling Action**

**Stage 1: Pre Delivery Stride**

During the Pre Delivery stride the bowler begins running up to the pitch from a measured distance behind the non-striker's wicket, gradually increasing in speed. Each bowler sets his run-up distance by personal preference. It varies from 30 or more meters for fast bowlers to four or five steps for slow bowlers.
Stage 2: Mid bound

Mid bound occurs in the last stride before the bowler reaches the pitch. (Bartlett, et al. 1996) In this phase the bowler jumps off his left foot and then lands on the right or back foot. The bowler engages in this stride with the shoulders pointing down the wicket and with the right foot passing in front of the left foot and then turning to land parallel to the bowling crease.

Stage 3: Back Foot Contact

During this stage the bowler's dominant foot lands on the pitch, near the non-striker's bowling crease. At this point the bowler's body is rotated so that the dominant side is trailing, with the bowling arm held down behind the body, elbow straight, with the hand near the waist. His other arm is held high in front of the body, and acts as a counterbalance.

Stage 4: Front Foot Contact

In this stage the bowler's leading or front foot lands on the popping crease. The bowler then brings his leading arm down while lifting his dominant arm up in an arc behind his body (Bartlett, et al. 1996). When both of the bowlers' feet are planted on the pitch, the bowler then swivels his body around to bring his dominant shoulder forward, while his arm reaches the top of its arc above his head. His other arm also reaches the bottom of its counterbalancing swing. The bowler's upper torso flexes forward to provide additional momentum to the ball.

Stage 5: Ball Release

During this phase the bowler releases the ball from his dominant hand near the top of its arc above the bowler's head.

Stage 6: Follow Through

Here the bowler follows through with a few more steps down the pitch, veering off to the side to avoid running on the area of the pitch where the ball lands. (Bartlett, et al. 1996)

Types of Bowling Action

Three basic bowling techniques have been identified by Bartlett, et al. (1996. These are the side-on, front-on and mixed techniques. It is almost impossible to isolate the boundaries between these techniques. (Bartlett, et al. 1996)

The side-on technique is considered the most correct and effective bowling technique. A bowler using this technique typically assumes a rear foot position that is parallel to the popping crease and at rear foot strike points his shoulders straight down the wicket, with a line passing through the bowlers shoulders being parallel to a line between the wickets. (Bartlett, et al. 1996)
A fast bowler who adopts the front-on technique typically assumes a rear foot position that points straight down the wicket towards the direction the ball travels and has a more open-chested position with the line through the bowler's shoulders creating an angle closer to 90 degrees with the line passing through the wickets. (Bartlett, et al. 1996)

The mixed technique is a mixture of the two techniques described above. A bowler utilising this technique adopts a front-on foot and shoulder orientation at back foot strike and then realigns his shoulders to a more side-on position during his delivery stride. (Bartlett, Stockill, Elliot, & Burnett, 1996)

**Types of Bowling**

There are a number of different types of deliveries that medium and fast bowlers bowl in an attempt to get batsmen out. A bouncer is bowled short so that it bounces steeply and is often aimed towards the batsman's head. Bowlers often try to bowl a Yorker which is a ball that pitches over a full length, almost landing under the batsman's bat which is difficult for the batsman to negotiate. The slower ball is another delivery often used by fast bowlers. This delivery is a disguised change in pace, in which the bowler bowls the ball slower than his normal speed. An in swinger is a delivery which swings into the batsman after bouncing, and an out swinger swings away from the batsman after bouncing. (Stretch, 1993)

Spin bowlers impart rotation to the ball before release by using either wrist or finger motions, the aim is for the ball to bounce and then deviate off the pitch before it reaches the batsman, thus making it difficult for the batsman to play the ball. (Lewis, 1992) Spin bowlers fall under the category of slow bowlers. (Stretch, 1993)

**CRICKET INJURIES**

Cricket is one of the world's major team sports and as of the year 2005 was the first sport to publish consensus on international injury definitions (Orchard J, Newman D, Stretch R, Frost W. Mansingh A & Leipus A, 2005). Injuries in cricket are common, particularly to fast bowlers (Orchard J, James T, Alcott E, Carter S, Farhart P 2002 & Newman D, 2003). It is accepted that ongoing injury, surveillance is the fundamental pillar of successful injury prevention. (Van Mechelen W, Hlobil H & Kemper H, 1992) Hence, there is general agreement internationally that cricket should follow the Van Mechelen paradigm of injury surveillance being the basis for risk factor and interventional studies which can ultimately lead to injury prevention. (Elliott B & Khangure M, 2002) Successful ongoing injury surveillance in even major sports has proven
elusive, partially because of the difficulties in forming consistent injury definitions. (Finch, Elliott, & MC Grath, 1999) This lack of consensus has severely limited the ability to compare injury rates between countries and to ascertain risk factors for injury. Injury surveillance in professional cricket in Australia has been prospectively undertaken continuously since the start of the 1998-99 seasons. Data from seasons 1995-96 to 1997-98 are available as a result of retrospective survey using a number of different methods. (Orchard J, James T, Alcott E, Carter S & Farhart P, 2002) The only known attempt at previous injury surveillance in Australian cricket was performed by Hoy and Payne in the mid-1980s. Group (SSMAG), the injury survey is now an ongoing core component of cricket research in Australia. It will not only continue to provide a framework to highlight the most important areas which need further study, but also, in the long-term, injury surveillance can follow trends in injury rates to test the interventions which are recommended by other studies. (Van Mechelen W, Hlobil H, Kemper H, 1992) (Elliott B, Hardcastle P, Burnett A & al. e, 1992)

Lower back injury remains the most important injury problem in professional cricket with lumbar stress fractures in fast bowlers accounting for the most lost playing time. Previous research has associated workload, Para spinal muscle asymmetry and technique factors with lower back injury in fast bowlers, however, preventative strategies such as workload directives and coaching guidelines have not reduced the incidence and prevalence of these injuries. (Ranson, 2010)

**The causes and types of injuries in cricket:**

The most common types of injuries are strains, sprains, fractures, bruising and open wounds.

- Injuries to the upper body namely the hand and finger are most common, followed by the lower body and the head and face.
- Injuries to the face, finger and hand from a cricket ball are the most common types of hospital-treated injuries, followed by falls.
- Overuse injuries are common and often associated with back and shoulder injuries among bowlers. (Sherrard, Stretch, & Cassell, June 2006)

**The Epidemiology of Low Back Injury in Fast Bowlers in Cricket**

Athletes who participate in sports that involve repetitive flexion/extension, lateral flexion and/or rotation of the lumbar spine have been shown to have a higher incidence of low
back pain (LBP) and spinal abnormalities compared with athletes in sports without these characteristics (Sward, Hellstrom, Jacobsson, & Peterson, 1990). Spondylolysis (stress fracture of the pars interarticularis) and intervertebral disc degeneration of the lumbar spine are two of the most common pathological conditions identified in athletes participating in sports that place high demands on the lumbar spine (Jackson, Wiltse, & Cirincione, 1976), (Soler, 2000), (Alyas, Turner, & Connell, 2007). Further, athletes in these sports clearly demonstrate a higher incidence of spondylolysis compared with the non-sporting population (3-6%). (Standaert & Herring, 2000) Sward 7 reported a much higher incidence of lumbar disc degeneration, defined as disc height reduction on conventional radiographs and reduced disc signal intensity on MRI, amongst wrestlers and gymnasts when compared with non-athletes. (Sward, 1992)

Low back injury to fast bowlers is the biggest injury problem in the sport of cricket (Orchard, James, Alcott, Carter, & Farhart, 2002), (Orchard, James, & Portus, 2006). In 1995 the Australian Cricket Board commenced a prospective injury surveillance program of all senior State and National level cricketers. From this program, the reported injury prevalence rates (percentage of squad members not available for selection due to injury for any given match) were approximately 3% for batsmen, compared with 16% for fast bowlers (Orchard, James, Alcott, Carter, & Farhart, 2002), (Orchard, James, & Portus, 2005). Lumbar spine injuries are recognized as the injury category resulting in the greatest amount of missed playing time amongst Australia’s State and National team fast bowlers. Of the specific diagnoses in this category, stress fractures of the partes interarticulares of L4 and L5 on the side contralateral to the bowling arm have by far the greatest prevalence (Orchard, James, Alcott, Carter, & Farhart, 2002), (Orchard, James, & Portus, 2005). English County Cricket injury surveillance statistics report a slightly higher prevalence of fast bowler injury (18%), with low back injury, particularly lumbar stress fractures, again accounting for the most lost playing time (Newman, 2003).

The first reports of high rates of low back injuries in fast bowlers began to appear in the scientific literature in the late 1980’s. (Foster, John, Elliott, Ackland, & Fitch, 1989) in a prospective study of back injuries in high performance adolescent bowlers, reported an 11% incidence of lumbar stress fracture in this group during one competitive season. A subsequent computed tomography (CT) study by Elliott et al. 10 of a similar group, found that 55% of participants were found to have abnormalities (pedicle sclerosis and pars stress fracture) in the posterior bony elements of the lumbar spine (pedicles and parts interarticulares) and 65% were
identified as having evidence of lumbar disc abnormalities. Premature disc degeneration has been reported in as many as 21% of young bowlers with a mean age of 13.6 years and 58% of bowlers with a mean age of 16.3 years. Engstrom and colleagues (Engstrom & Walker, 2007) used MRI scanning to examine the lumbar spines of a cohort of 51 junior elite fast bowlers on an annual basis over a four-year period. The authors reported a 24%(12/51) incidence of symptomatic pars interarticularis stress injury development in this group during the period of the study. Furthermore, 92% of these injuries were reported to have occurred at the L4 level, exclusively on the side contralateral to the bowling arm. Other studies have reported that acute lumbar stress injuries in fast bowlers mostly occur at the L3 to L5 lumbar levels with most located on the non-dominant (non-bowling arm side) of the lumbar spine. (Foster, John, Elliott, Ackland, & Fitch, 1989), (Gregory, Batt, & Kerslake, 2004) The vast majority of lumbar spondylolyses (stress fractures) occur in the lower lumbar spine, with between 85% and 95% being reported to occur at the L5 spinal level and 5% to 15% at the L4 spinal level.

Although no precise relationships between the degree of disc degeneration and incidence of LBP were reported in these investigations, evidence from this and other studies of the general population, would suggest that these pathological changes in the lumbar spine are likely to increase the risk of clinically significant LBP (Luoma, Riikimäki, Luukkonen, Raininko, Viikari, & Lamminen, 2000), (MacGregor, Andrew, Sambrook, & Spector, 2004).

There is however, some debate in the wider LBP literature regarding the relationship between LBP and radiological abnormalities and biomechanical factors (Nachemson, 1999), (Adams & Dolan, 2005). This debate has arisen previously as MRI studies examining asymptomatic participants have demonstrated a high prevalence of disc degeneration and derangement. Further, other investigations have found that genetic predisposition (MacGregor, Andrew, Sambrook, & Spector, 2004), (Battie, Videman, & Parent, 2004), (Videman, Battie, Ripatti, Gill, Manninen, & Kaprio, 2006) has a greater influence on lumbar patho-anatomical findings than physical factors. In addition, psycho-social factors such as stress levels, job satisfaction and the work environment correlate more closely with the incidence of LBP than either radiological findings or biomechanical influences (Boos N, et al., 2000), (Videman, Battie, Gibbons, Maravilla, Manninen, & Kaprio, 2003.). Conversely, MRI investigations conducted by Macgregor and colleagues 24and Luoma and co-workers 23 have found that the degree of disc degeneration was a strong predictor of a history of severe LBP. Similarly, Kjaer
and colleagues reported most MRI degenerative disc abnormalities e.g. irregular nucleus shape, reduced disc height, hypointense disc signal, annular tears, disc protrusions and endplate changes, to be moderately associated with LBP.

**Pain relief**

Cooling, compression and rest usually provide relief from pain in soft tissue injuries. Pain relieving medication may be given if the examination is complete but should be avoided in the early stages as it can complicate further treatment if continued analysis and medical examination are required. Medication can be used for soft tissue injuries such as aspirin, paracetamol, anti-inflammatory like diclofenace sodium, ketoprofen, naproxen and ibuprofen which have relatively good pain-relieving and anti-inflammatory effects but definitely their side effects include gastric irritation should not be renounced (Lars & pensrom., 1988)

**Treatment and Prevention of Low Back Stress Fractures in Cricket**

In most cases, complete rest from sport is the treatment of choice. This would usually be for a period of 6 weeks to allow the bone to heal. During this period a progressive exercise program may commence, under the supervision of a chartered physiotherapist. This usually starts with exercises to increase the muscular stability in the lower back. Research has shown that a lack of muscular stability in the lumbar and pelvic regions can lead to low back pain.

Research has shown that specific exercises can be effective in relieving back pain and restoring normal function. These exercises are most effective for what is called 'mechanical low back pain', where the problem is caused by poor postural habits and the pain resulting from by disc problems. Once the correct technique has been mastered, these exercises are very easy to do. They are not too vigorous and they can be done by people of all ages.

The principle behind the exercises is that if certain specific muscles can be recruited or contracted, the spine will have much better support. This prevents postural faults which can predispose a person to back pain. (Gregory, Batt, & Kerslake, 2004)

In order to understand how these exercises are effective, it is necessary have a brief introduction to how the back is supported by muscles. The first muscle we are concerned with is called Transversus. This muscle arises from the middle of the tummy and goes right around the midriff, attaching itself to the spine. (Orchard J, James, Alcott, Carter, 2002)
The Transversus muscle acts as a natural corset and provides stability for the lower back. The second muscle involved in this exercise programme is the Multifidus. This muscle lies deep in the spine and attaches in between each vertebra. When it contracts it increases the stability of the spinal column. If you can contract the Transversus muscle, the Multifidus muscle is also contracted automatically. This improves spinal stability and can relieve back pain. (Stretch & Orchard, 2003)

Various treatments that can be helpful in relieving back pain include: Acupressure, Acupuncture, Aromatherapy, Exercise, Homeopathy, Hydrotherapy, Magnetic therapy, Massage, Supplements, and Allopathic Treatment. (Akinson, Egan, & Miller, 1991)

Although pharmacological methods are often the primary treatment for back pain, they have potential side effects (Vallerand, 2003) and are not always effective in treating back pain. The use of nonpharmacological methods along with pharmacological methods is highly recommended (Ferrell, Ferrell, & Rivera, 1995). As an adjunct to traditional pain management methods, empirical support for reflexology may provide physiotherapists with a new, noninvasive, treatment modality. Reflexology is a simple, readily available, comparatively inexpensive adjunct that can be administered by a person trained in reflexology. Pharmacological therapies often do not provide adequate pain relief and may have side effects with long-term use. Use of nonpharmacological adjuvant, such as reflexology may increase pain control and minimize the untoward effects of analgesics. Unfortunately there is a lack of scientific research to support nonpharmacological therapies (McCaffery & Pasero, 1999). In a review, it was reported that use of nondrug methods promoted coping abilities, hope, sleep, sense of control,
comfort, pain relief and quality of life. In addition, the adjuvants reduced the emotional component of pain, perceived threat, and fatigue (Doherty, 1995).

**Reflexology (Acupressure)**

Reflexology is a safe, noninvasive complementary therapy that involves application of direct topical pressure to specific points on the hands or feet thought to correspond to specific somatic organs. The topical pressure is applied by the index finger or thumb. Practitioners of reflexology state that the goal is to maintain or obtain wellness, not to diagnose. The specific points on the hands or feet are thought to be representative of various organs. The organs are said to lie in zones, sometimes called meridians, that are 10 longitudinal divisions of the body, 5 on each side. The organ zones are thought to have developed because of the proximity of all organs during fetal development. The organ zones rationale are the basis of reflexology's effectiveness, yet there is little empirical support for the mechanism of action (Booth, 1994).

Reflexology may induce a relaxation or calming psychological effect because of the physical contact involved. Reflexology may improve circulation and move waste products that have settled at the nerve endings that are thought to be pathways to the organs of the body. Reflexology has been reported to relieve or reduce acute and chronic symptoms, yet the method of action in terms of modern physiology remains unknown. Use of the descriptive gate control theory may support the rational for use of reflexology (Ingham, 1984).

**Gate control theory of pain**

Gate control theory of pain may explain the mechanism of action for reflexology. The gate control theory is one of modulation of painful impulses. Passage and blockage of pain impulses are modulate in the spinal cord and brain through complex neurophysical mechanisms. The gate is not in a specific anatomical location, but in numerous areas of central nervous system (Melzack and Walls, 1984). The gate’s status, whether it is open or closed, determines whether pain impulses are allowed access to the brain. One proposition is that cutaneous stimulation closes the gate to nociceptive impulses. Stimulation of large diameter nerve fibers, found predominately in the skin, may modulate passage of nociceptive impulses in the dorsal horn of the spinal cord (Melzack and Wall). In reflexology, tactile stimulation of the skin may stimulate these large pain inhibitory fibers, thus modulating the painful back impulses. Self-reported back pain will measured empirically using the SF-MPQ that is based on the gate control theory (Melzack and Wall, 1965).
Most people know that Reflexology is a foot massage, but fewer people know that it is also a very powerful healing tool. All the different organs and parts of your body can be accessed on your feet and hands and the sensitive fingers of the experienced reflexologist are able to detect imbalances in your body by the altered texture of certain areas of your feet. By paying particular attention to these areas, the reflexologist is able to restore the body to good working order. Here are some of the conditions that can be addressed with Reflexology: headaches and migraines, indigestion, nausea, constipation, hot flushes, period pains, back, neck, hip, shoulder, knee pain, balance problems and dizziness, high blood pressure and circulatory problems...and many more. Back pain among athletes the predominant, imposes adverse psychological, social, and economic effects on these individuals and their family. Ultimately, chronic pain diminishes the quality of life (Moskowitz & Haug, 1986)

History
Reflexology originated more than 5,000 years ago in China and India, and remerged in the United States in 1930s. It was rediscovered and renamed Reflex Zone Therapy by a physician, Dr. William Fitzgerald, the medical director of the Nose and Throat Department, at Saint Francis Hospital in Hartford, CT. The use of the technique has grown in popularity and there are many institutes of reflexology in Europe and a few in the United States (Lett, 1983). For more than fifty years the International Institute of Reflexology in St.Petersburg, FL, has provided seminars certification to the public, although certification is not mandatory for reflexology practice. The Reflexology Association of America issues newsletters about the technique and current legislation regarding complimentary therapies. (Booth, 1994)

What is Reflexology?
Reflexology is a natural therapy that can be used for pain relief and relaxation. Reflexology is a simple, non-invasive method to help balance the body. It has been described as a natural therapy that requires the application of a specific type of pressure on particular areas of the feet. It is based on the principle that there are reflexes in the feet which correspond to every part of the body. (Andersen & Hodgson, 2007)

Pain Relief and Foot Reflexes
You can notice profound relaxation and pain relief through the simple application of applying pressure to certain reflexes in the foot. Anything from stress, headaches to back pain or sinus congestion can be relieved by this technique. There are several reflexes around the toes that
relate to the nasal and sinus area of the head. To relieve sinus congestion, for example, several 
reflexes around the toes are manipulated in order to drain the sinus passages and to relieve the 
pressure in your ears. (Andersen & Hodgson, 2007)

**Mechanism of action**

Dobbs (1985) hypothesizes four potential mechanism of action for reflexology. One 
mechanism of action is that reflexology may correct an energy imbalance along the 
corresponding zone by the pressure applied. This pressure is thought to crush lactic acid or waste 
deposits that accumulate in the hands and feet. Due to gravity it is believed that more 
accumulation for waste deposits occur in the feet. The crushing action is thought to redistribute 
energy flow (Booth, 1994). Second, the pressure applied may change energy flow vibration in the 
electromagnetic fields of the body and may restore balance. Third, reflexology may induce a 
relaxation or calming psychological effect because of the physical contact involved. Fourth, 
reflexology may improve circulation and move waste products that have settled at the nerve 
ending that are thought to be pathways to the organs of body. Reflexology has been reported to 
relieve or reduce acute and chronic symptoms, yet the method of action in term of modern 
physiology remain unknown. This study proposes that another possible mechanism may be 
through the affect of cutaneous pressure that modulates nociceptive impulses as described in the 
gate control theory. (Melzack & Wall, 1965)

Gate control theory of pain may explain the mechanism of action for reflexology 
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passage of nociceptive impulses in the dorsal horn of the spinal cord. In reflexology, tactile 
stimulation of the skin may stimulate these large pain inhibitory fibers, thus modulating the 
painful back impulses. (Melzack R., 1996)
Benefits of reflexology

Research has shown the specific techniques of reflexology to be effective and beneficial in many ways. A survey of 170 reflexology studies from 21 countries shows that reflexology is effective, impacting a variety of physical and psychological concerns. Reflexology:

- Creates relaxation: From the moment the reflexologist’s hands start their work, the relaxation begins as shown in research using EEG brain activity. All together, 24 studies demonstrate reflexology’s relaxation effects.
- Reduces pain: Pain reduction following reflexology work is documented in 27 studies including research showing impact on individuals of all ages and health states.
- Ameliorates health concerns: Research shows that reflexology work helps individuals of all ages with some 78 health concerns ranging from aggressive behavior in children to urinary concerns of the elderly.
- Improves blood flow: Separate studies show that reflexology work increases blood flow to the feet, brain, kidneys and intestines.
- Aids post-operative recovery: Reflexology work aids recovery after surgery as shown by several studies, reducing pain and lessening the use of post operative analgesics.
- Impact on physiological measures (e.g. blood pressure and cholesterol; measurements by ECG, EEG, and MRI)
- Enhances medical care: Reflexology helps where nothing else can for many: phantom limb pain sufferers, neuropathy patients, and hemodialysis patients to name a few.
- Benefits mental health: Research demonstrates that reflexology can reduce depression (11 studies) and anxiety (9 studies).
- Complements cancer care: Pain, nausea, vomiting, and/or anxiety eased for chemotherapy patients following reflexology work as shown by 16 studies from 7 countries.
- Eases pregnancy, delivery and post-partum effects: Women who received reflexology experienced shorter labor times and used less analgesia. In addition, reflexology showed a positive impact on postpartum depression, anxiety, urination and bowel movements.

In general terms, the benefits of reflexology have to do with the reduction of stress. Because the feet and hands help set the tension level for the rest of the body, they are an easy way to interrupt the stress signal and reset homeostasis, the body’s equilibrium.
Reflexology is a complement to standard medical care. It should not be construed as medical advice. It should not be a replacement to medical help. Please use it wisely. We care about your safety. (Oleson & Flocco, 1993)

Researchs in reflexology

Literally hundreds of reflexology studies have been conducted. Our survey of 170 studies show a positive result for 83% of areas researched. A Chinese survey of 8,096 case studies noted a 94% effective or significantly effective rate. Significant areas of study include: stress and anxiety; lessening of pain and cancer care as well as health concerns for individuals of all ages. (Kunz & Kunz, 2000)

Stress and Anxiety

Lessening of stress and anxiety is demonstrated in twenty-nine reflexology studies with study participants including healthy individuals, senior citizens, women and cancer patients. The stimulation of reflexology’s pressure techniques creates change in the body’s basic level of tension as demonstrated by research showing that reflexology relaxes the body using a variety of measurements: brain waves (EEG), blood pressure, systolic blood pressure, diastolic blood pressure, pulse rate, and anxiety. (Kunz, 2004)

Lessening of Pain

Reduction of pain is a significant result of reflexology work. The lessening of pain in response to reflexology is documented in thirty-six studies including individuals of all ages and health states: birthing mothers, menstruating women, phantom limb pain sufferers, lower back pain sufferers, cancer patients, kidney stone patients, senior citizens and individuals with pain resulting from surgery. Such results find explanation is what researcher Dr. Nancy Stephenson considers as affect on the neuromatrix of the brain, an expansion of the Fate Control Theory of Pain. According to Wikipedia: "Gate control theory asserts that activation of nerves which do not transmit pain signals, called nonnociceptive fibers, can interfere with signals from pain fibers, thereby inhibiting pain." Stimulating nerves that sense touch, heat, cold and pressure- as does reflexology- overcomes the action of the pain nerves. (Kunz, 2004)
STATEMENT OF THE PROBLEM

The problem selected for investigation in the present study has been titled as “The Effect of Reflexology on Back Pain among Cricketers“

OBJECTIVES OF THE STUDY

The following were the objectives of this study:

1. To assess and compare the cricketers with self-reported back pain who received reflexology and the cricketers who received a placebo treatment.
2. To assess and compare the cricketers with self-reported back pain who received reflexology and control group.
3. To assess and compare the cricketers with self-reported back pain who received a placebo treatment and control group.

HYPOTHESES

The study was pivoted around the framework of the following hypotheses:

1. Cricketers with self-reported back pain who received reflexology would have significantly less pain than control group.
2. Cricketers with self-reported back pain who received a placebo treatment would have significantly less pain than control group.
3. Cricketers with self-reported back pain who received reflexology would have significantly less pain than cricketers who received a placebo treatment.

DELIMITATIONS

The following were the delimitations of this study:

The study was delimited to the male athletes.
The study was delimited to the cricketers only.
The study was generalized only to short-term effects on back pain.
The study was delimited to the back pain injury.
The study was delimited to the cricketers between 15-25 years of age.

LIMITATIONS

The following were the limitations of this study:

1- No special technique would be used to motivate the subject during the administration of the tests.
2- Several variables such as duration of injury, nutrition during the administration of the study, home environment, daily routine, psychological status, socio-economic status, medicines, and other treatments of the subjects would not be controlled.

3- The training of the participants could not be controlled.

CONCEPTUAL DEFINITIONS

For the purpose of this study, the following terms were used:

1- Reflexology: is a “science that deals with the principle that there are reflex areas in the feet and hands which correspond to all of the glands, organs and parts of the body”. (Moskowitz & Haug, 1986)

2- Back pain: who is suffering from backache and cannot continue training or cannot participate in matches. (Hills, 2009)

3- Cricketers: who that plays cricket and cricket is an outdoor game played with bats, a ball, and wickets by two teams of 11 players each. In this study cricketers mean male cricketers who participated at least 3 years in cricket competitions. (Orchard J. Newman D, Stretch R. Frost W, Mansingham A & Leipus A, 2005)

SIGNIFICANCE OF THE STUDY

Since current pharmacological back treatment does not provide complete pain relief and has potential adverse side effects, a combination of pharmacological and non pharmacological treatment methods are necessary. Physiotherapists need to reduce pain and side effects of medications though research and development of complementary therapies. Although Physiotherapists use complementary therapies in their practice and see positive improvements in their clients' conditions, there is insufficient empirical research (McCaffery & Pasero, 1999). If reflexology can be empirically supported for pain relief, in may be a nursing intervention that is cost effective because it may later be shown to reduce analgesic use and associated side effects, and improve quality of life for athletes with self-reported back pain. Once efficacy is supported, the techniques involved in reflexology should be taught to patients and their families. The education benefits the psychosocial well being and health of the back pain patients and families play an important role in coping with the emotional aspect of back pain. Physiotherapists need to develop a knowledge base in nonpharmacological adjuvant to reduce pain and suffering in athletes with back pain. This knowledge base can lead to more researches. (Booth, 1994)
CHAPTER-II

REVIEW OF RELATED LITERATURE