UNIVERSITY OF ALBERTA

THE INCIDENCE OF SACROILIAC JOINT DYSFUNCTION OCCURRING IN MIDGET-AGED MALE HOCKEY PLAYERS WITH LOW BACK PAIN

BY

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Science

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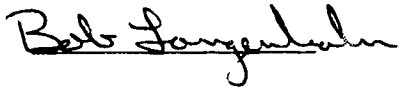

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The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled The Incidence of Sacroiliac Joint Dysfunction Occurring in Midget-Aged Male Hockey Players with Low Back Pain submitted by Robert Langenhahn in Partial fulfilment of the requirements for the degree of Master of Science.

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DEDICATION

This thesis is dedicated to my parents for all the nutritional, emotional, and financial support they provided to allow it's completion.

ABSTRACT

The purpose of this study was to identify the prevalence of sacroiliac joint dysfunction in midget-aged male hockey players as a potential cause of the low back pain from which they may suffer. Forty-one players 15 to 17 years of age, and from three different Alberta Midget Hockey League Teams, participated in this study.

Each volunteer athlete was asked to complete a questionnaire which allowed the athletes to be divided into three groups: Group One: Midget Aged Male Hockey Players who have experienced an episode of LBP in the 1993-94 season; Group Two: Midget Aged Male Hockey Players who have not experienced an episode of LBP in the 1993-94 season; and Group Three: Midget Aged Male Hockey Players who do not experience LBP. Group One contained eleven people, Group Two: nine, and Group Three: five. Each athlete was asked to attend one testing session lasting approximately one hour. An athlete who was discovered as experiencing SIJD was required to be positive on at least three out of the following five clinical tests: Stand, Sit, Gapping, Approximation, and the Prone Knee Bend. Each athlete was reviewed by three examiners, and an agreement between two of the three examiners must have existed before SIJD could be confirmed or rejected.

Preliminary analysis of inter-examiner agreement revealed that the percentage of agreement between all three examiners was 44%. The percentages of agreement between examiner one and two, and one and three, respectively, were 52% and 64%. The percentage of agreement existing between investigators two and three was 72%.

Further, on two of the five designated exams, the Stand and Sit tests, examiner one recorded positive findings of 76% and 80%, in contrast to Examiner two (44% and 36%, respectively) and Examiner three (52% and 52%). Due to the low inter-examiner agreement and a tendency to identify positive rather than negative results, led to the deletion of Examiner one's results from the study. Given this, the results of the 16 subjects assessed only by Examiner one, were also excluded, yielding a final sample of 25 athletes. A fourth examiner was obtained and of the 25 athletes considered, only 3 were found to possess a form of SIJD.

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CHAPTER ONE: THE PROBLEM

INTRODUCTION

Low back pain (LBP) is a common occurrence in everyday life as a large number of people are victims of this complaint. Deusinger (1989) proclaims that low back pain is experienced by every individual at least once during his or her lifetime. Citing the report of the Department of Health and Human Services in the United States reveals that approximately thirty-one million individuals experience LBP of which thirteen million have significantly impaired function (Lindsley, 1992). Once thought to be an affliction of manual labourers, Fenety (1989) cited research showing relationships between LBP and prolonged posture, trunk bending, and, of importance to this study, athletic participation. However, Harvey and Tanner (1991) relate that "Back pain is reported to occur in 85% of the general population but in only 5 to 8% of the athletic population." (p. 395)

When considering the adolescent population, the presence of LBP is relatively unknown. Harvey and Tanner (1991) believe that it is also further complicated by the non-specificity of the LBP which makes a diagnosis very difficult. In their survey of the incidence of LBP in adolescent children, Mierau, Cassidy, Hamin, and Milne (1984) found that out of 135 secondary school students, aged 12-17, 45 (33.3%) had LBP. Kujala, Salminen, Taimela, Oksanen, and Jaakola (1992) found that in this same population, the prevalence of LBP increased with age, with females being more affected than the males. The athletic adolescent population, in particular, poses an interesting question regarding LBP. Burton and Tillotson (1991) communicate that increased

frequency of back trouble in school aged boys was attributed to increasing levels of sports participation. They also refer to an investigation done by Balogue, in which he found a significant correlation between LBP and competitive sports participation in 14 year olds, a finding that was absent in the non-competitive population. A comparable finding was reported by Kujala et al. (1992), who identified a positive association between LBP and participation in competitive sports. Harvey and Tanner (1991) identified a number of factors that may predispose the young athlete to back injury. These factors are: growth spurts, training errors (poor conditioning of the spine), improper technique (poor biomechanics), poor equipment, leg length inequality, repetitive stresses due to the nature of the sport, and poor fitness.

Although interest has existed in the sacroiliac joint (SIJ) since the time of Hippocrates (Walker, 1992), and appears to be an accepted problem during pregnancy (Broadhurst, 1989), the sacroiliac joint seems to have been commonly overlooked when considering the causes of low back pain. Many clinicians are under the impression that "Because nonspecific back pain often precedes disk herniation, the disk is a likely source of the preceding idiopathic back pain" (DonTigny, 1990, p. 250). The SIJ can and should be considered a potential source of LBP, as sacroiliac joint dysfunction (SIJD) may cause acute or chronic LBP and, if compromised, give the appearance of a posterior dysfunction of the SIJ or a superior iliac shear. It can also mimic disk disease by causing pain on leaning forward, pain on sitting, and pain when coughing or sneezing (DonTigny, 1990). A person suffering from SIJD may present all or some of the following symptoms: pain in the low back slightly to one side, pain over the 'dimple' in

the region of the posterior superior iliac spine, pain that is referred into the buttock, and pain on standing, sitting, or rolling over in bed (Broadhurst, 1989). The acuteness of pain in the SIJ may not be indicative of the site of causation. Gatterman (1990) describes that the most acute tenderness is frequently found in the SIJ contralateral to the one that is jammed or locked. Pain from the SIJ may also be easily and erroneously attributed to the lumbar spine or hip disease as a broad sensory supply, made up of at least eight segments of the spinal cord, services the SIJ. This not only results in pain being commonly experienced in the low back or buttocks as mentioned above, but also into the posterior thigh, the anterior thigh, and the groin (Gatterman, 1990). The disorders that can arise at the SIJ are categorized as: inflammatory, infectious, mechanical, degenerative, and Osteitis Condessans Ilii (Corrigan and Maitland, 1983). The mechanical disorders are of most significance to this study. The two major ailments in this area are hypomobility and hypermobility. Corrigan and Maitland (1983) communicate that hypomobility usually occurs in young people and may be associated with activities that place a rotational stress on the SIJ. Hypermobility is considered to be rare but occurring predominantly in athletes due to instability in the pelvis. The mechanisms that lead to SIJD are questionable, but the most relevant to this study include twisting, a fall on the buttock, muscle imbalance (especially the flexors, extensor, and internal and external rotators of the hip), or leg length disparity (Cibulka, 1989). Leg length discrepancies play a vital role in sacroiliac joint dysfunction as it may be both a cause (more often) and a result of this condition. Leg length discrepancies cause an unequal transmission of force across the spine during weight bearing activities. This is

further accentuated when the athlete moves quickly and the stress transmitted through the spine is amplified by acceleration of the body mass (Harvey and Tanner, 1991). The non-relevant cause to this study identified by Cibulka (1989) is pregnancy.

SIJD has been variously termed subluxation, upslip, downslip, or posterior, or more frequently, anterior fixed innominate (Walker, 1992). More specifically Bourdillon, Day, and Bookhout (1992), listed the dysfunctions of the SIJ as: 1) anterior torsion of the sacrum about the hypothetical oblique axis (reported as left on left or right on right); 2) posterior torsion of the sacrum about the oblique axis (reported as left on right or right on left); 3) unilateral anterior (or inferior) nutation of the sacrum (unilateral sacral shear or flexion); and 4) unilateral posterior (or superior) sacral nutation (unilateral superior sacral shear or extension). Greenman (1990) agreed with this classification but expanded on this idea by including two others: bilateral anterior nutation and bilateral posterior nutation. Additionally, all of the above dysfunctions may be either primary or secondary in origin. Primary dysfunction arises from trauma such as direct contact, falls on the buttock, or attempts to prevent falling. Secondary dysfunction comes on slowly, and is usually compensatory to scoliosis with pelvic tilt or with inequality in leg length (Gemmell and Jacobsen, 1990). "The most common problem athletes develop in the pelvis is low back pain from sacroiliac joint dysfunction. Bourdillon suggests that the sacroiliac joint is the single commonest cause of low back pain" (Cibulka, 1989, p.777).

In the study done by Mierau et al. (1984), within a group of 403 elementary and secondary students, the overall incidence of SIJD was reported to be 33.5% . In a similar investigation of 83 fit college students, Gemmell and Jacobson (1990) reported

SIJD in 27.3% of the students with LBP, 15.2% of the high fitness group, 35.3% in the average fitness group, and 19.3% of the total group. Also described by Gemmell and Jacobson (1990) is a study which showed that in one day, out of all the people that reported to a chiropractic center, SIJD was present in 57%. When considering these statistics, it is apparent that SIJD is a common occurrence in a variety of populations. However, it remains to be seen if SIJD will be present in an athletic group such as midget aged male hockey players.

STATEMENT OF THE PROBLEM

This research study was centered on a hypothesis that SIJD is present in midget-aged (15-17 years of age) male hockey players with LBP because of the necessity of forward trunk flexion in performance of the skills in ice hockey. The motions of bending, lowering, twisting, and lifting in combination with forward trunk flexion are present in the required skills of skating, passing, shooting, and body contact. Consequently these athletes are predisposed to low back pain which may be from SIJD. This hypothesis does not imply that all hockey players will exhibit low back pain or SIJD, but in those who experience LBP, SIJD may be present.

"The common onset of SIJD occurs with an anterior shift of the line of gravity, when leaning forward to perform some task" (DonTigny, 1990, p.256). When a player leans forward to perform various skills, the anterior weight shift causes an anterior rotation force on the pelvis. When this rotation occurs, the posterior ligaments of the sacrum are loosened and the thin sheath of the anterior sacroiliac ligaments offers only

limited protection of the SIJ. Consequently, if the anterior pelvis is not supported adequately by the abdominals, the SIJ is vulnerable to dysfunction anteriorly (DonTigny, 1985). Though the most commonly identified lesion of SIJD is posterior dysfunction, DonTigny (1985) believes that posterior dysfunction probably does not exist. This belief is supported by the fact the SIJ functions most efficiently in the absorption of compressive forces when the innominates rotate posteriorly on the sacrum where it is well protected by the dense posterior ligaments (DonTigny, 1985). When the line of gravity is posterior to the acetabulum, the concurrent posterior rotation of the pelvis enhances the caudal gliding of the sacrum on the ilia. When the line of gravity moves anteriorly with the anterior rotation of the pelvis, caudal gliding, which helps to decrease stress on the lumbar disks (especially between the fifth lumbar vertebrae and the first sacral vertebrae), is lost. This loss may lead to SIJD (DonTigny, 1990). (See Figure 1-1 A and B, pp.28)

The severity of SIJD will be increased with rapidity of the weight transfer and the amount of weight added to the upper trunk during any lifting, bending, lowering, or twisting (DonTigny, 1990). The completion of many of the skills of hockey require great speed and force to accomplish. As Fenety (1989) described, physical contact and variations in individual style and technique have been identified as various causes of low back pain. Both of these factors will increase the stresses in the back which may produce SIJD or aggravate a preexisting SIJD. The completion of the slap shot utilizes forward trunk flexion, trunk rotation, and the generation of muscular force to impart to the puck. Physical contact, which is an essential part of midget hockey, commands that

the body be put in various positions that facilitate the use of force to repel the opponent while at the same time maintaining one's own balance. In contrast to other sports where physical contact is absent, a higher incidence of LBP is reported in sports such as football and hockey where contact and high speed collisions are frequent and expected elements. The aforementioned examples of shooting and physical contact illustrate how the forces generated by hockey players can influence a sacroiliac joint problem.

The problem is, therefore, that in midget aged hockey players with low back pain, sacroiliac joint dysfunction may be present and, if so, may provide an explanation for the pain from which they suffer. If this research discovers that sacroiliac joint dysfunction is a common occurrence in midget-aged male hockey players who suffer from low back pain, a greater awareness of this disability in this sport will result, which in turn will facilitate better treatment of this condition.

RATIONALE FOR THE STUDY

As suggested in the previous section, if SIJD is identified within the midget-aged male hockey population, greater insight into the condition may result, improved recognition and treatment of this ailment may occur, and lastly enhanced prevention through pre-season and in-season maintenance of appropriate muscle strength and range of motion may flourish.

OPERATIONAL DEFINITIONS

Low Back Pain (LBP): is herein defined as pain occurring in the lumbar spine

region from the inferior costal border to the gluteal fold, excluding sciatic pain referred beyond the buttock.

Sacroiliac Joint Dysfunction (SIJD): is herein defined as the impaired or altered function of the sacroiliac joint which produces low back pain to be experienced by the individual. This condition can be identified through diagnostic or clinical tests that examine movement at this joint or reproduce the patent's pain.

DELIMITATIONS

This study was delimited to:

1. The testing of male midget aged hockey players with low back pain and those who were pain free. In the case of low back pain, the low back pain must not be related to work, a pre-existing condition that has been diagnosed by a physician (eg. disc prolapse, surgery), or a motor vehicle accident;
2. Subjects who were 15 to 17 years of age as of the first of January, 1994;
3. Subjects who were playing in the Alberta Midget Hockey League as of the first of January, 1994, and who had played at least 20 games of midget hockey in the 1993-94 season up to the time of testing; and
4. The evaluation of the bony landmarks of the spine and pelvis, active, passive and resistive movements of the trunk and hip for identification of sacroiliac joint dysfunction in standing, sitting, supine and prone lying positions.

CHAPTER TWO: REVIEW OF THE LITERATURE

ANATOMY OF THE SACROILIAC JOINTS

The sacroiliac joints have been referred to as the keystone of the arch between the two pelvic bones where, together with the symphysis pubis, they play a crucial role, not only in hockey, but in everyday life. Before discussing any aspect of the SIJ, a basic understanding of the anatomy of the joints should be provided. For purposes of the discussion the sacroiliac joints will be described as a single entity unless other wise stated.

Magee (1987) describes the SIJ as part synovial and part syndesmosis, located between the articular surfaces of the sacrum and ilium. A syndesmosis is a type of fibrous joint in which the intervening fibrous connective tissue forms an interosseous membrane or ligament. The synovial portion of the joint is "C" shaped with the convex iliac surface of the "C" facing anteriorly and inferiorly and with the sacral surface being slightly concave. Magee (1987) reports that the greater or more acute the angle of the "C", the more stable is the joint and the less chance of injury occurring.

The size, shape, and roughness of the joint surfaces vary greatly among individuals. In children these surfaces are smooth. In adults these surfaces have irregular elevations and depressions which result in the partial interlocking of the bones, thereby adding strength to the joint but restricting its movement. Brooke (1924) and Alderink (1991) add that with the advent of puberty marked changes between the sexes appear with regards to the SIJ. In males the changes progress along lines of strength and security,

while in women the joints become more mobile. Brooke (1924) believed that, "...the ligaments thicken and become stronger, to meet no doubt the increased strain involved in the harder physical tasks which fall to man's lot". (p.299) The sacroiliac joints also tend to become progressively stiffer or immobile with increasing age (Magee, 1987; Brooke, 1924).

The sacrum and the ilium are firmly held together by the two strongest ligaments in the body: the interosseous and posterior sacroiliac (SI) ligaments (Moore, 1992; Walker, 1992). The interosseous ligaments are massive and very strong, and they unite the iliac and sacral tuberosities. They are composed of short, strong bundles of fibres that blend with, and are supported by, the firm thick posterior sacroiliac ligaments. According to Moore (1992), these ligaments are composed of strong, short transverse fibres joining the ilium and the first and second tubercles of the lateral crest of the sacrum. They also contain long vertical fibres that unite the third and fourth transverse tubercles of the sacrum to the posterior iliac spines. The posterior SI ligaments blend in with the sacrotuberous ligament, an accessory ligament to the SIJ. The third and weakest of the primary SI ligaments is the anterior (ventral) SI ligament. It is described as a thin, wide sheet of transverse fibres that is located on the anterior and inferior aspect of the SIJ, covering the abdominopelvic surface of this joint. Moore (1992) reminds us that most or all of these ligaments are often replaced by bone after fifty years of age.

There are three accessory ligaments that Moore (1992) identifies that also add to the strength of this articulation. These are the iliolumbar ligament, sacrotuberous ligament, and the sacrospinous ligament. The iliolumbar ligament is a strong, triangular

ligament that connects the tip of the fifth lumbar vertebra to the iliac crest posteriorly. The inferior fibres of this ligament attach to the lateral part of the sacrum, called the lateral lumbosacral ligament. This ligament is very important as it limits the rotation of the fifth lumbar vertebra on the sacrum and assists the vertebral articular processes in deterring the anterior glide of the fifth lumbar vertebra on the sacrum. Broadhurst (1989) identifies the iliolumbar ligament as the most important of all the ligaments as when there is SI pain, this ligament is truly painful. The sacrotuberous ligament passes from the sacrum to the ischial tuberosity, having a wide attachment to the dorsal surface of the sacrum, coccyx, and the posterior superior iliac spines (PSIS). The final accessory ligament is the sacrospinous ligament running from the lateral margin of the sacrum and coccyx to the ischial spine. Both the sacrotuberous and sacrospinous ligaments bind the sacrum to the ischium and they resist posterior rotation of the inferior end of the sacrum. These two ligaments also hold the posterior portion of the sacrum inferiorly, therefore preventing the body weight from depressing its anterior part at the SIJ. These ligaments do allow movement of the sacrum to occur thereby affording some resilience to the pelvic region when sudden weight increases are applied to the vertebral column (e.g, when landing on the feet after a fall) (Moore, 1992). See Figures 1-2 and 1-3, p.29.

A unique characteristic of the SIJ is the fact that no muscle crosses over it. Walker (1992) points out that the surrounding musculature (quadratus lumborum, erector spinae, gluteus maximus and minimus, piriformis, iliacus, and latissimus dorsi) have fibrous expansions that blend with the anterior and posterior SI ligaments and contribute

to the strength of the joint capsule and ligaments and to the joint's stability. DonTigny (1990) and Cibulka (1992) both identify the erector spinae musculature as prime candidates in the production of pain and trauma in the SIJ, due to their small attachment and their large generation of force. Magee (1987) illustrates that the adductor muscles of the thigh and the rectus femoris muscle may also have an affect on the SIJ. Any muscle that attaches to the pelvis has the potential to increase any symptoms arising from a SIJD. It is therefore important in the assessment of the SIJ to include active, passive, and resisted movements to identify any pain or weakness.

The neurovascular supply to this unique joint of the body is provided by a large number of structures. The arterial supply of the SIJ is derived from the superior gluteal, iliolumbar, and lateral sacral arteries. The innervation of the SIJ are derived from the superior gluteal nerve, the sacral plexus, and the dorsal rami of the first and second sacral nerves (Moore, 1992). As mentioned earlier, with such a broad sensory supply pain may be referred throughout the entire distribution affecting a number of different anatomical areas. Gatterman (1990) postulates that this may be a reason why pain that originates in the SIJ may be easily and erroneously attributed to the lumbar spine or to hip disease.

FUNCTION OF THE SACROILIAC JOINTS

Despite many studies, the precise function of the SIJ is still a mystery (DonTigny, 1985; Stevens, 1990). Greenman (1989) believes that functionally the innominate bone should be viewed as a lower extremity bone and the two sacroiliac joints as the junction

of the vertebral axis and the lower extremity. Gatterman (1990) believed that the pelvic ring, composed of the SIJ posteriorly and the pubic symphysis anteriorly, form a mechanism that functions similarly to the three joint complex of the typical vertebral motion segment. Alderink (1991) believed that the SIJ work in conjunction with the other joints of the pelvic ring to provide a screw home mechanism of stability. With most research work on the back being focused on the lumbar spine, the research done on the SIJ has provided minimal evidence towards function or dysfunction. This absence seems to have been interpreted as the absence of function or dysfunction (DonTigny, 1990).

Scanning the literature provides basically two functions of the SIJ that a number of studies tend to agree with. These functions are: 1) transmission of body weight both from above and ground forces from below and 2) energy absorption (Alderink, 1991; Broadhurst, 1989; DonTigny, 1985; Corrigan and Maitland, 1983; Brooke, 1924). Transmission of body weight from above and ground forces from below and energy absorption can only be accomplished because the SIJ is capable of motion (which will be discussed below). There is a debate as to whether or not the SIJ is a weight bearing or non-weight bearing joint, as the sacrum has been described as functioning as the keystone of an arch. However, the keystone of an arch becomes wedged more tightly as weight is applied from above. In reality the sacrum is suspended between the ilia by the dense posterior SI ligaments which allows it to perform gliding movements thereby permitting the SIJ to function as a shock absorbing structure. If the sacrum was truly a keystone, the SIJ would not be capable of shock absorption as the weight from above would force

it to become wedged between the innominates (Gatterman, 1990; DonTigny, 1990). Both of the functions listed above are of great importance to the proper mechanics of not only the SIJ, but to the whole body as a functioning unit.

MOTION OF THE SACROILIAC JOINT

The premise that the SIJ is a locus of low back pain rests on the assumption that the SIJ is capable of motion (Walker, 1992). This has been a point of great conjecture however as many different sources tend to contradict one another. Lee (1989) emphasizes that authors from the time of Hippocrates (460-377 B.C.) to Vesaluis (1543 A.D.) felt that under normal conditions, excluding pregnancy, the SIJ were immobile. This view was upheld until de Diemerbroeck (1689) demonstrated that mobility of the SIJ could occur apart from the pregnant state. However, in the adolescent population, the bones that form the pelvic complex only begin to ossify during puberty and can remain unossified until 25 years of age resulting in greater mobility at the SIJ (Lee, 1989). Potter and Rothstein (1985) reported that the irregular joint configuration and the tendency to develop early osteoarthritic changes at the SIJ have led many to deny that motion transpires at the joint. For years the subject of SIJ movement was argued and was considered not clinically significant. However, as Greenman (1989) points out, the SIJ is now considered to perform small movements along a number of axes.

The axis about which the movement at the SIJ is said to occur is also an article of debate as the literature has identified a number of centres of movement. Bourdillon (1990) and Greenman (1989) suggested an oblique axis, running from the superior pole

of one SIJ to the inferior pole of the other, as the prime axis of movement. DonTigny (1990) describe this axis as a transverse axis of rotation that can be observed near the central aspect of the SIJ. Gatterman (1990) reported an axis of rotation centered around the iliac tubercle, directly posterior to the SIJ, with motion transpiring in an oblique sagittal plane. In Lee (1989), Weisl concluded that the axis of motion for any SIJ movement is located outside of the joint and is a moving axis of rotation depending on the action at the SIJ. It can be seen that there are many different beliefs as to what axis the SIJ completes its activity on. However, this is not the primary issue when contemplating SIJ motion. (See Figure 1-4, p.30)

Sacroiliac motion is the movement of the sacrum between the two innominate bones and requires the participation of both sacroiliac joints (Greenman, 1989). Gatterman (1990) and Corrigan and Maitland (1983) agree that although the movement is only a few millimetres and within a very small range, it is essential that this movement be maintained. Walker (1992) relates that "Motion must occur both to create sacroiliac joint dysfunction and more importantly, to substantiate manual therapy designed to relieve symptoms and restore function."(p.904) The sacral motions about which the most is known are nutation and counternutation (contranutation). Nutation can be described as a nodding movement of the sacrum between the innominates where the sacral base moves anteriorly and inferiorly, while the sacral apex moves posteriorly and superiorly. Counternutation is the reversal of the above mentioned action where the sacral base moves posteriorly and superiorly while the sacral apex moves anteriorly and inferiorly (Greenman, 1989). (see Figure 1-5, p.30) Corrigan and Maitland (1983) explained that

this type of nodding motion has been confirmed by a number of researchers through a variety of methods. They identified that Weisl in 1954 utilized cineradiography in living subjects, Colachis et al in 1963 inserted wires into the iliac spines of medical students, while Frigerio, Stowe, and Howe in 1973 used a computerized X-ray technique in cadavers and living subjects. A translatory or gliding component of sacral movement also exists with nutation and counternutation (Greenman, 1990). With nutation there is a caudal translation of the sacral base and with counternutation a cephalad translation. Brooke (1924), Gatterman (1990), Lee (1989), and Macnab and McCulloch (1990) all identify a rotary component of SIJ movement that is small yet essential to the proper mechanics of the joint. Basically, the SIJ should be described as a six degree of freedom joint where the simultaneous combination of translation, nutation or counternutation, and rotation occur, thereby permitting a different response in both weight bearing and non-weight bearing activities (Walker, 1992; Alderink, 1991). Any movement of the sacrum on the innominates has the possibility of disrupting the intimacy of the matching surfaces making the SIJ anatomically susceptible to dysfunction (DonTigny, 1985; Gatterman, 1990)

CLINICAL TESTS FOR SACROILIAC JOINT DYSFUNCTION

Before one can suspect the presence of SIJD one must be aware of the symptoms which this ailment will elicit. As mentioned previously a person suffering from SIJD may present all or some of the following symptoms: pain in the low back slightly to one side, pain over the 'dimple' in the region of the posterior superior iliac spine, pain that

is referred into the buttock, and pain on standing, sitting, or rolling over in bed (Broadhurst, 1989; Gemmell and Jacobsen, 1990). The acuteness of pain in the SIJ may not be indicative of the site of causation. Pain from the SIJ may also be easily and erroneously attributed to the lumbar spine or hip disease as a broad sensory supply made up of at least eight segments of the spinal cord service the SIJ. For this reason it is imperative that a clinical examination involving the hip and lumbar spine be completed to rule out other conditions that may be mistaken for SIJD (Corrigan and Maitland, 1983; DonTigny, 1985). SIJD not only results in pain being commonly experienced in the low back or buttocks as mentioned above, but also into the posterior thigh, the anterior thigh, and the groin (Gatterman, 1990). Pain and tenderness at the symphysis pubis may also be present when an SIJD is suspected (Cailliet, 1988; Corrigan and Maitland, 1983; Harvey and Tanner, 1991). Because the pelvis is a closed ring and cannot undergo stretching at one site only, as when the SIJ are displaced, the pubic symphysis must also suffer some disruption (Macnab and McCulloch, 1990). The referral of pain from the SIJ may also be experienced in the abdomen, localized at Baer's point (halfway between the right anterior superior iliac spine (ASIS) and the pubic symphysis), which may be confused with inter abdominal lesions (Corrigan and Maitland, 1983). Torsional strain of the SIJ may be responsible for the construction of the pain at Baer's point and mobilization of the SIJ can relieve it (DonTigny, 1990). Taking this all into consideration it is evident that a thorough and complete examination is required when screening for SIJD. As Cailliet (1988) believed "the examination is a tissue analysis as well as a position and movement analysis clarifying where and what tissue is responsible

for the pain" (p.107).

The various studies which have concentrated on SIJD have used a great number of clinical or diagnostic tests to confirm the presence of SIJD. Different claims have been made as to which is the most reliable; however, the tests that are utilized are known to yield measurements of questionable reliability (Cibulka, 1992). Generally all the tests used in the identification fall into one of the following two categories: 1) palpation of bony landmarks with and without measurement, and 2) pain provocation tests. (Walker, 1992). The tests of palpation include:

Standing forward flexion test (Stand test): With the subject in a standing position, the examiner palpates the inferior slope of both PSIS as the patient bends forward in the motion of touching his toes, with the knees in full extension. The motion of the PSIS are compared to each other. A dysfunction is present if: both PSIS are not equally superiorly and anteriorly, and is labelled if one is more superior or anterior than the other. An abnormal motion will occur if this is present as the downward and backward glide of the two limbs of the SIJ is lost, and the innominate and sacrum move as one unit on the positive side. A false positive test can occur if the opposite hamstring is asymmetrical (shortened) or there is a true leg length difference. An observation of the thoracic and lumbar spines also occurs with this test and any compensatory scoliosis or altered segmental rhythm is looked for. This test is used to identify any dysfunction at the symphysis pubis and the iliosacral joints. (Freer, 1993)

Stork Test A: With the subject standing, the investigator palpates the spinous process of the second sacral vertebrae and the PSIS on the right side. The subject is then asked to raise his right leg by bringing the right leg to the chest. Here the examiner follows the movement of innominate in relation to the sacrum. The normal movement is the PSIS moving inferiorly in relationship to the sacrum. The test is considered positive if the PSIS moves superiorly. The test is then repeated for the other side and the movements are compared. (Freer, 1993)

Stork Test B: Very similar to the Stork Test A except that the examiner now contacts the inferior edge of the crest of the sacrum and ischial tuberosity on each side. The examiner follows the movement of the innominate in relationship to the sacrum. With normal movement the ischial tuberosity moves laterally and anteriorly. The test is positive if the ischial tuberosity moves superiorly. (The modified Stork B tests assesses the same movement but involves the palpation of the spinous process of the second sacral vertebrae and the ischial tuberosity.) (Freer, 1993)

Gillet Motion Palpation: 1. With the subject standing the examiner places his/her thumbs bilaterally over both PSIS while gripping the ilium with his/her fingers. The patient is then asked to raise his leg to his chest by flexing the knee and hip. The movement of the PSIS of the flexed leg is compared to the PSIS of the standing leg. 2. The second Gillet motion procedure requires the subject to be standing while the examiner contacts the PSIS on one side and the spinous process of the second sacral vertebra. The player is asked to bring his leg to his chest as in the first test. Normal movement is associated with a downward movement of the PSIS. (This test is exactly the same as the Stork A Test.) (Herzog et al, 1991)

Sit Test (Piedallu's): The subject is asked to sit on a hard flat surface and the examiner palpates the PSIS, as the subject leans forward as far as possible. The examiner is looking for forward or superior movement at the PSIS. The heights of the PSIS are evaluated and if one PSIS is found to be lower, and upon forward flexion this PSIS becomes the higher one, the test is considered positive and it is that side which is affected. This indicates an abnormality in the torsion movement at the SIJ. (Magee, 1987)

Medial malleolar levels (supine and sitting): With the subject first in a supine position, the investigator palpates the inferior aspect of each medial malleolus and compares the level with the other. The examiner determines if they are equal or if one is shorter or longer than the other. The subject is then asked to move into a sitting position while the investigator maintains contact with the malleoli. The examiner is looking for any difference in the levels of the malleoli in the two positions. A positive test is produced when an observable change in relative lower extremity lengths occurs. A negative test results when no change in length is apparent after changing positions. This test helps to determine the direction in which the innominate bone is tilted. With a posterior tilt the lower extremity appears short when lying supine, whereas with an anterior tilt the lower extremity appears longer when lying supine. Upon sitting the short leg becomes the long one and the long leg the short one. (Cibulka, 1989)

Prone Knee Bend: With the subject in a prone position, the investigator contacts the bottom of the heel on both feet and looks for a difference in their levels. Maintaining contact with the heels, the knees are then flexed to ninety degrees (90) to see if any change in the level of the heels occur. A positive test ensues when an observable change occurs between the prone leg length and prone knee flexion. A negative test results when no observable change occurs between the two positions. (Cibulka et al, 1988)

Palpatory tests are utilized to detect malalignment by identifying asymmetry between the left and right innominate bones, while movement tests are used to detect

reduced movement of one SIJ when compared to the opposite side (Cibulka, 1988). The motion palpation tests can be used in the male midget aged hockey population as, according to Gemmell and Jacobsen (1990), in young people these tests are practical and usually informative as the SIJ have not yet become immobile as in the adult population. Potter and Rothstein (1985), Broadhurst (1989), DonTigny (1990), Cibulka (1992), Walker (1992), and Leblanc (1992) all agree that these palpation tests have been found to be of low reliability and therefore preference should be given to the pain provocation tests which provide higher reliability and more meaningful results. The pain provocation tests for SIJD include:

Straight Leg Raise (SLR): With the subject in a supine position, the examiner passively flexes the hip with the knee extended through as full a range of motion (ROM) as possible. The presence of pain and it's location during passive movement is ascertained in this test. Pain that occurs after seventy degrees is indicative of joint pain, which may arise at the SIJ. (Magee, 1987)

Gapping (anterior): With the subject in a supine position, the examiner makes contact with the ASIS, and then pushes down and out to stress the anterior sacroiliac ligaments. The examiner is looking for the production of pain in the low back or gluteal region resulting in a positive test which may indicate a sprain of the anterior sacroiliac ligaments. (Magee, 1987)

Gapping (posterior): The subject is in a supine position and contact is made with the lateral surfaces of the iliac crests which are then pushed in a direction towards each other. The reproduction of pain in the low back is being attempted by stressing the posterior SI ligaments.
(Gatterman, 1990)

Approximation (Pelvic Compression): The subject is in a side lying position and the examiner contacts the iliac crest and downward pressure is applied. This movement is intended to elicit feelings of pressure or pain in the SIJ, indicating a possible sacroiliac lesion and/or a sprain of the posterior sacroiliac ligaments. (Magee, 1987)

Patrick's Test (FABER): The subject is lying supine and the examiner places the foot of the test leg on the opposite knee. The examiner then lowers the test leg in abduction towards the table, which may produce pain in the SIJ indicating a positive test. (Magee,

1987)

Spring test (Sacral Apex Pressure): With the subject lying prone the examiner places a hand on the apex of the sacrum and then applies pressure to this point. If pain is produced in the SIJ, it is considered a positive test. (Magee, 1987)

Squish: The subject is in a supine position and contact is made with the ASIS and iliac crests by the examiner. Pressure is applied downward and at a forty-five degree angle in the hope of producing pain in the SIJ, therefore testing the posterior SIJ ligaments. (Magee, 1987).

Sacroiliac Rocking (Knee to Shoulder): The subject is in a supine position and the investigator flexes the knee and hip and then fully adducts the hip, and brings it towards the opposite shoulder. This movement intends to elicit pain in the dysfunctional SIJ, an indication of a positive test. (Magee, 1987)

Gaeslen's Test: The subject is in a side lying position with his upper leg hyperextended at the hip, and his lower leg stabilized against the chest. The examiner stabilizes the pelvis while extending the hip of the upper leg. Pain indicates a positive test and may suggest an ipsilateral SIJ lesion. This test may also be performed in supine lying, with the subject extending the test hip beyond the edge of the table. The subject then draws both legs up onto his chest and then slowly lowers the test leg down into extension, and it is compared to the control side. Pain in the SIJ are indicative of a positive test. (Magee, 1987)

Yeoman's Test: The subject is in a prone, supine, or side lying position while the examiner stabilizes the pelvis and extends the each hip one at a time with the knee extended. Pain with this manoeuvre will indicate the site of involvement. Usually with an SI lesion the prone patient is able to extend the leg much higher on the side that is less involved. (Gatterman, 1990)

The complicated nature of SIJD requires that more than one test be positive for identification of sacroiliac pain (Broadhurst, 1989). The reliability of a combination of tests for SIJD has been shown to be good, whereas the reliance on only one test may lead to false negative results (Cibulka, 1992; Gemmell and Jacobsen, 1990). The only study reviewed which identified SIJD as being present through the use of only one diagnostic test was Keene et al (1989). This research used the Patrick's test where a

positive result was indicated by pain over the SIJ. Generally speaking "The more tests that are positive, the more accurate the diagnosis" (Leblanc,1992, p.1462). Cibulka and Delitto (1988; 1993) required that at least three of the four following tests be positive before SIJD was said to exist: the Standing forward flexion test (Stand test), the Long Supine Sitting test (Medial malleoli), the Prone Knee Bend, and asymmetry of the PSIS when seated. These authors found the reliability of detecting SIJD to be high when using this combination of tests. Corrigan and Maitland (1983) employed the following tests in their study: Spring Test, Approximation, Gapping, and resisted abduction and adduction of the hip. Macnab and McCulloch (1990) utilized the Approximation, resisted hip abduction, and Gaeslen's test in their efforts for SIJD detection. Kirkaldy-Willis (1988) evaluated SIJD through the Gaeslen's, Patrick's, Yeomann's, and Stork A, and a slightly modified Stork B tests. This modification involved the palpation of the PSIS and the spinous process of the second sacral vertebrae, rather than the lateral edge of the sacrum and the ischial tuberosity. Herzog et al. (1989; 1991) used two diagnostic exams in their search for SIJD from the Gillet motion palpation procedure. The first involved the palpation of both PSIS with a comparison of the movement of the PSIS of the flexed leg and the standing leg. The second Gillet procedure used was the Stork test A. Borenstein and Wiesel (1989) used a combination of tests which included: Stork A and B (slightly modified), Patrick's, Gapping (anterior and posterior), Approximation, Gaeslen's, and the Knee to Shoulder. Gatterman (1990), in her study, used very similar tests to Borenstein and Wiesel adding only the Yeoman's and Straight Leg Raise and omitting Gaeslen's and the Knee to Shoulder tests. Leblanc (1992) continued the trend

of including a number of tests for SIJD evaluation. This research employed the Patrick's, Squish, Gaeslen's, Knee to Shoulder, Stork Test A, Gapping, and Approximation tests.

The individual authors also identified individual tests which they believed positively identify SIJD. Neumann (1990) praised the Standing or Seated Flexion test as the most reliable indicators of SIJD. DonTigny (1990) believed that the use of the Straight Leg Raise (SLR) is essential in the analysis of low back pain as pain produced on the contralateral side during the SLR is indicative of anterior SIJD. Contrary to the popular opinion regarding the palpatory motion tests, Herzog et al (1991) and Gemmell and Jacobsen (1990) favoured the Gillet motion palpation procedure 2 (Stork A) test. Gemmell and Jacobsen (1990) believed that because of high mean percentages of agreement of 85.3% for inter-tester and 89.2% for intra-examiner reliability, these tests are useful for a single examiner to determine SIJ mobility. Potter and Rothstein's research (1985) identifies that intertester reliability figures for the Gapping and Compression tests achieved 90% and 70% respectively, the only two tests in their study which relied on the patient's response to the therapist's actions.

As it can be seen from this review, each researcher had a preference for different exams when evaluating for SIJD. However there was considerable overlap with regards to the tests selected. By selecting a combination of these tests, in conjunction with the palpation of correct anatomical structures and an analysis of the active, passive, and resisted movements of the subject, a complete and thorough examination for SIJD will result. "The important aspect in all musculoskeletal medicine is that the therapist must

be able to reproduce the patient's pain, this enables a more accurate diagnosis of the pain" (Broadhurst, 1989, p. 623).

BACK INJURIES IN HOCKEY

Injuries in hockey can range from facial lacerations to deep quadriceps contusions. Midget "AAA" hockey is fast, aggressive, and very competitive where injuries are very commonplace. This level of hockey is often the stepping stone for many players to enter into junior and then, possibly, professional hockey. Midget hockey players are between the ages of fifteen to seventeen years old, and may play up to sixty or seventy games in one season. Unlike professional or junior hockey players, these players are required to wear facemasks. Although the use of masks has drastically reduced the amount of facial lacerations, it appears they also may be a causative factor in other injuries that arise. Gerberich, Finke, Madden, Priest, Aamoth, and Murray (1987) commented that the face mask has altered the nature of the game of ice hockey by giving players such a feeling of invincibility that they take excessive and unwarranted risks during games or practices. Sixty-six percent of players interviewed reported that the facemasks have allowed themselves to be more aggressive in their style of play (Gerberich et al. 1987). This increased aggressiveness may lead to more serious soft tissue injuries and, of importance to this research, back injuries.

Literature in the area of hockey injuries has mostly been limited to the professional or college ranks with only a small number of these recording back injuries. One study of interest was performed by Gerberich et al. (1987). They examined 251 high school hockey players in Minnesota during the 1982-83 hockey season. The mean age

of these players was 16.1 years (standard deviation of 1.0) and the mean number of years of hockey experience was 8.80 years. The researcher found that back injuries accounted for 6% of all recorded incidences that occurred during this particular season. Although the specific type of back injuries were not recorded, of the 229 players who were injured, 35 reported that they had experienced some sort of low back pain during the season. In general, it was discovered that a total injury rate of 75 injuries per 100 players could be expected with most injuries occurring during games (82.3%). The older, taller, and heavier players were injured more often as were the players with greater playing experience. Gerberich et al. (1987) also found that significant differences between injured and non-injured players with regards to position played, with the defence and wings accounting for the greater majority. Sim, Simonet, Melton, and Lehn (1987) cited a report by Hayes that reported results of 61% of forwards and 41% of the defence experienced some type of injury. Reeves (1970) studied the number and types of injuries in the Edmonton Minor Hockey Association. He found that midget-age hockey players accounted for 17% of all injuries. Reeves also spoke about an inquiry accomplished by Toogood and Love (1976) which found 56% of all injuries transpired in the fourteen to eighteen year old age group. Another study by Sutherland (1976) reported a similar finding. He studied hockey players in an Ohio High School League team, the Bowling Green University team, and the Toledo Goaldiggers, a professional International Hockey League team. Sutherland (1976) related that out of a sample of 207 High School hockey players only 41 injuries occurred. Only two of the 41 injuries were back injuries, which resulted from severe body checks. The 25 university players incurred only sixty-two

injuries, none of which involved the back. The 17 Toledo Goaldiggers reported only one back injury out of the fifty-one insults recorded. Unfortunately, out of the damages to the back, no specific information was provided that identified the precise problem the players experienced. However, Sutherland (1976) related that as the level of play and age increases, the number and severity of the injuries increases. A survey performed in Denmark which consisted of fourteen professional teams and 210 players recorded that 7% of all injuries that were observed involved the back. This research, conducted by Jorgenson and Schmidt-Olsen (1986), specifically identified that the 13 back insults contained one strain, one contusion, and eleven of unknown circumstances. Out of these 13 injuries, 45% happened at practice, with the remaining 55% during competition. For treatment of their conditions 31% of the players saw a physiotherapist, 31% consulted a physician, and 38% did not receive any treatment at all. With regards to position, the breakdown of these injuries were: goaltenders, one; defence, four; forwards, seven; and one that was unknown. Keene, Albert, Springer, Drummond, and Clancy (1989) completed a ten year study that specifically looked at the number of back injuries that occurred in seventeen varsity sports at the University of Wisconsin. This survey involved 4790 athletes, of which 393 suffered a back injury. Overall, injuries in the lumbar spine accounted for the greatest majority of back problems (81% of the subjects had pain in this area). Sacroiliac joint dysfunction was reported as appearing 12 times, with football (four), and gymnastics (three) being the most problematic. Out of 4790 athletes, 276 were hockey players. Only 17 injuries were found in this group. These injuries included eight strains, one disc injury, one kissing spine, one spondylolysis, two

contusions, two episodes of scoliosis, one vertebral body fracture, and one of unknown origin. No episodes of sacroiliac joint difficulties were found involving hockey players. Tegner and Lorentzon (1991) and Lorentzon, Wedren, and Pietila (1988), working with Swedish elite hockey players found that back injuries accounted for 11.4% and 15.8% of the recorded injuries in their respective studies.

Many of the studies that were reviewed examined the type and incidence of injuries for at least one season as compared to the three month period in which this study is focusing. Near the end of the regular season and during playoffs, a more intense and competitive style of play seems to be the norm which often results in an increase in the number of injuries experienced. Reeves (1970) confirmed this belief, as he found 28.9% of all injuries took place during the last quarter of the season due to the increase in competitiveness and expanded use of body contact.

Figure 1-1 Pelvic Rotation

Figure A

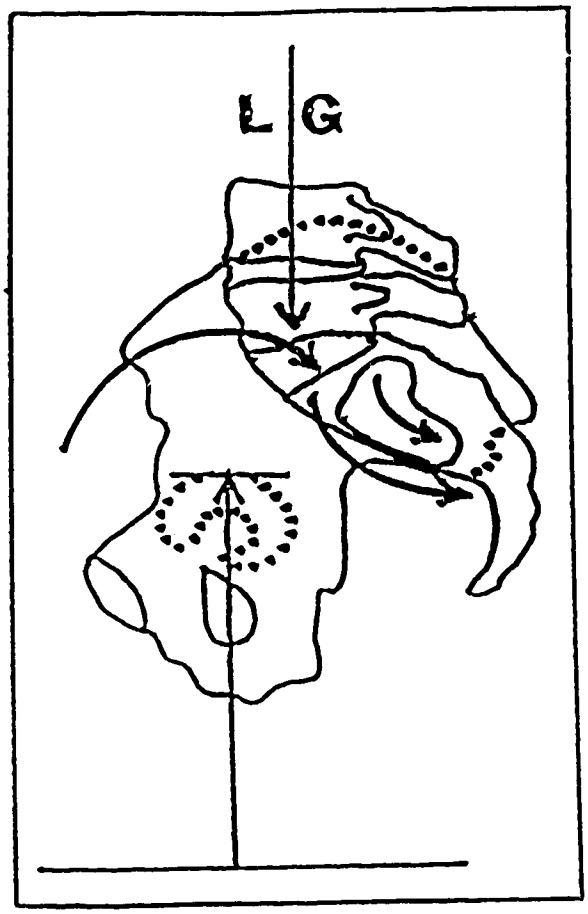


Figure B

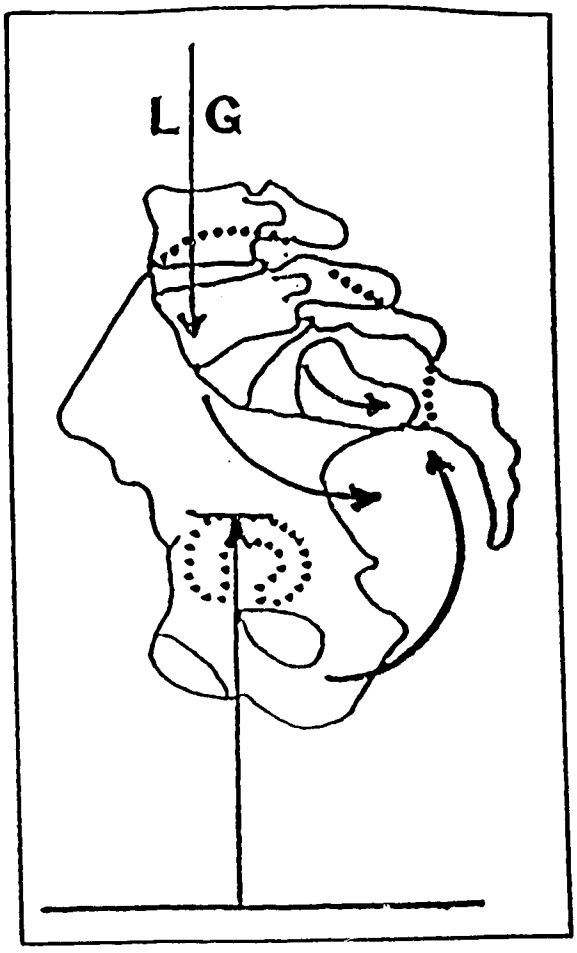


Figure A: When the line of gravity (LG) is posterior to the acetabula, the concurrent posterior rotation of the pelvis, the Sacroliliac Joints are well protected by the dense posterior ligaments

Figure B: When the LG ia anterior to the acetabula, the Sacroiliac Joints are vulnerable to anterior dysfunction.

Figure 1-2 Anterior View of the Pelvis

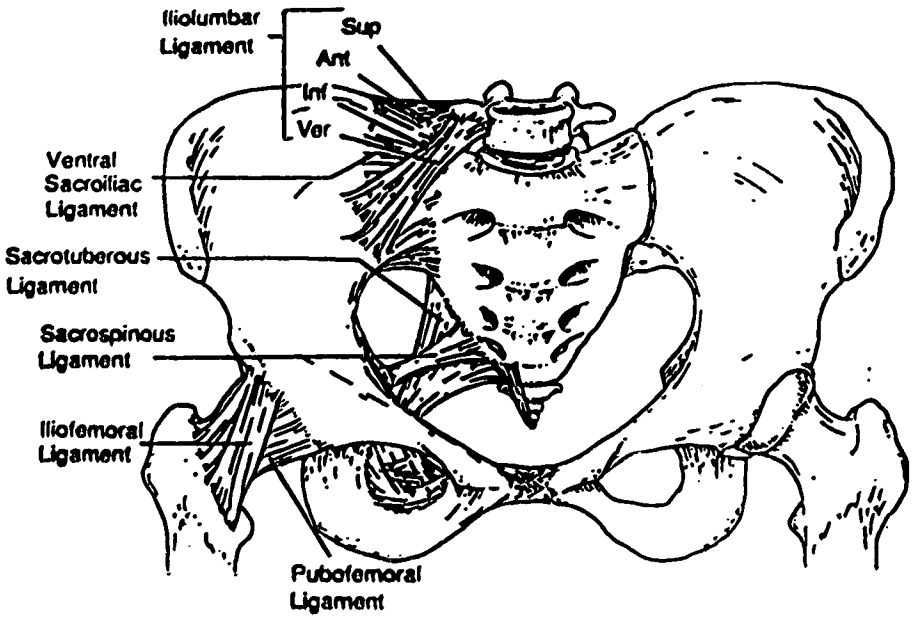


Figure 1-3 Posterior View of the Pelvis

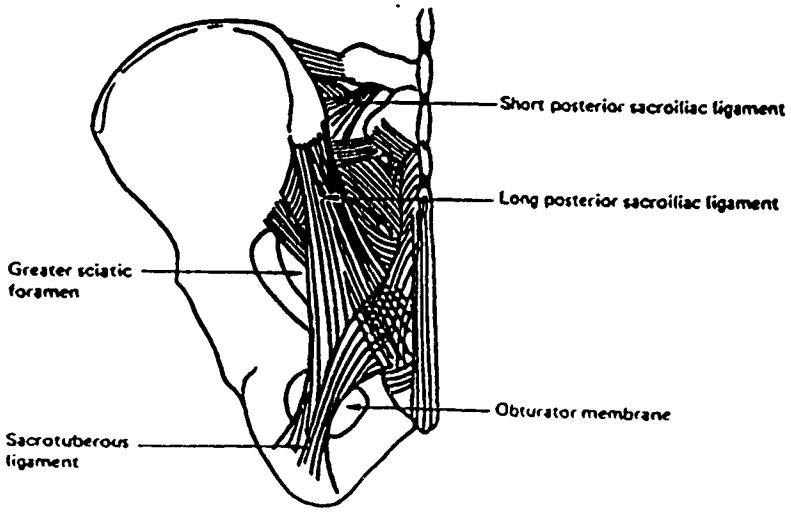


Figure 1-4 Proposed Axes of Rotation

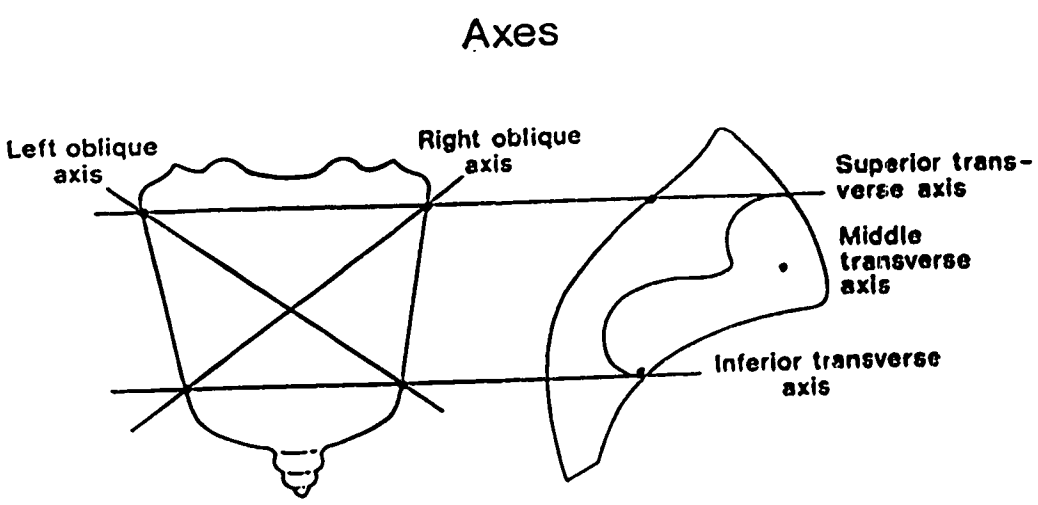
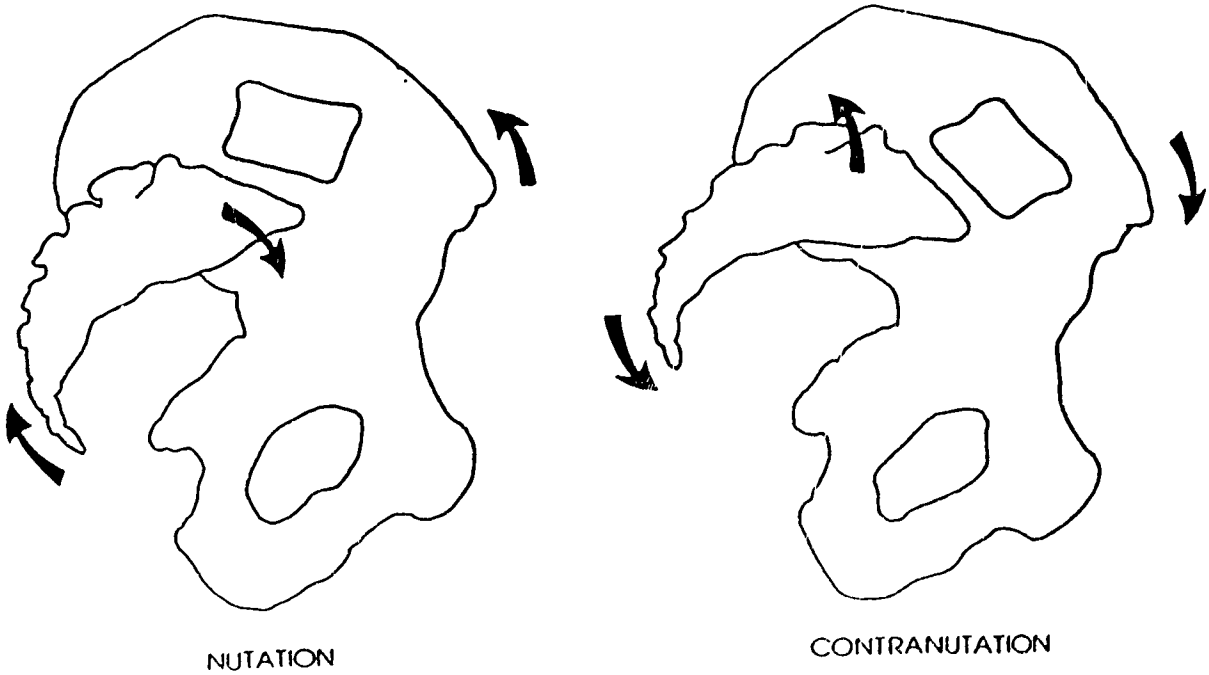


Figure 1-5 Nutation and Contranutation



CHAPTER THREE: METHODS AND PROCEDURES

INTRODUCTION

The methods and procedures followed to assess the incidence of SIJD in midget-aged male are described in the present chapter. The order of presentation is: research design, subject identification, method, physical assessment of the subjects, assessment procedures training session, ethical considerations, and data collection and analysis.

RESEARCH DESIGN

This study was designed to be non-experimental and descriptive in nature. The fundamental purpose of descriptive research is to describe characteristics or variables in populations by directly examining samples (Payette, 1993).

SUBJECT IDENTIFICATION

Subject recruitment took place through discussion with the coaches of the following local Alberta Midget Hockey League teams: Leduc Firebirds, Edmonton Southside Athletics, and St. Albert Eagle Raiders. These teams were considered as they play in an aggressive and highly competitive league as witnessed by the body contact and intense effort present in each game. At the time of initial contact with the coaching staffs of the participating teams, all facets of the study were explained and all questions pertaining to the study were answered (See Appendix A). After the coaches agreed to allow their players to participate in the study, personal contact with the players and the

investigator took place. All aspects of the study were explained to the players. Each of the players who volunteered for this research was provided with a consent form for himself and his parent(s) or legal guardian. Completion and return of both forms was necessary before testing could commence (see Appendix A). The subjects were then asked to complete a Back Injury Questionnaire (see Appendix B). This questionnaire aided the investigator in the identification and classification of the subjects into the appropriate groups. There were three groups of classification:

I. Midget aged male hockey players with LBP who experienced an episode of LBP during the 1993-94 season.

II. Midget aged male hockey players with LBP who did not experience an episode of LBP during the 1993-94 season.

III. Midget aged male hockey players who have never experienced LBP.

The questionnaire also ensured that each subject met the inclusion criteria of each respective group:

Group I:

1. Subjects must experience low back pain that causes:

   A. Pain or ache at rest in the region of the costal border to the gluteal fold,

   B. Difficulty in either sleeping, standing, or sitting, and

C. Pain that is aggravated during or immediately following training or competition.

2. Subjects have played at least twenty games of midget hockey in the 1993-94 season.

3. Subjects must have experienced an episode of LBP in the 1993-94 season.

Group II:

1. The subjects must have experienced an episode of low back pain that meets the first two inclusion criteria for Group I, but not the third criterion, i.e., the players in this group must have experienced an episode of LBP prior to, but not during, the 1993-94 season.

Group III:

1. The subjects report no episodes of LBP.

Subjects were excluded from this study if they:

i) suffered from low back pain that was attributed to work, a physician's diagnosis (e.g, disc prolapse), or to a motor vehicle accident; and/or ii) had not played at least twenty games of midget hockey during the 1993-94 season.

Additionally the subjects had to be 15 to 17 years of age. The questionnaire was also used to collect other essential information. Firstly, each athlete was asked to

indicate the number of years he had played competitive ice hockey. The athlete was then asked if he had experienced episodes of low back pain. If so, the athlete was requested to describe the incidence, location, and cause of the LBP, and, what, if any, medical treatment he received for his LBP.

METHOD

After confirmation that an athlete qualified for the study, the athlete was assessed. Initial plans called for each athlete to be assessed by three examiners, consisting of two males and one female. However, due to time constraints, 16 of the 41 athletes who were assessed were examined by only one examiner. All testing was completed at The Sport Rehabilitation and Training Center, located at 4940-93 avenue, Edmonton, Alberta, with all testing sessions occurring before games or training sessions. At each testing session the subjects were examined in a random order with each examiner testing a different subject at the same time. Each examination lasted about ten to fifteen minutes after which the examiners would rotate to the next patient. In the case of the 25 athletes assessed by all three examiners, no discussion between examiners occurred so as not to bias one another before seeing the next player. The testing sessions were carried out over a period of one month to enable a convenient time to be arranged for the subjects and examiners. To ensure that a correct diagnosis of SIJD was to occur, an examination of the relationship between certain anatomical landmarks and functional motion testing transpired. (Neumann, 1990). To meet this goal and allow an adequate examination of this unique joint, each athlete was required to perform active, passive, and resisted range

of motion activities in standing, sitting, and supine, and prone lying positions. The athlete also underwent physical examination (palpation) of the bony landmarks of the spine and pelvis, again in a variety of positions. Finally the athlete was subjected to a battery of clinical tests that specifically identified movement or elicited pain in the sacroiliac joints. The pain they may have experienced from these tests was only a reproduction of the low back pain they usually experience. The reproduction of this pain was considered a positive finding in many of the tests used to identify SIJD. As before, these tests were performed in a variety of positions. A basic axiom of evaluating the functional basis of low back pain that this research followed was, "If the characteristic pain can be produced by a position or by a movement, and the precise relationship of that position and movement to the functional anatomy of that part is understood, the cause of that pain becomes clear" (Cailliet, 1988, p.107). To facilitate the testing, the athletes wore only athletic shorts or appropriate underwear.

PHYSICAL ASSESSMENT OF THE SUBJECTS

This study relied on the physical examination of the subjects in order to determine if SIJD was present in this sample population. This assessment was divided into the components of palpation, active movements, passive movements, clinical tests, and resisted isometric tests. Because the identification of SIJD is very complicated, a full description of all aspects of each of these components is essential to enhance the understanding of the required elements of this examination.

PALPATION

Palpation is the physical examination of the bony landmarks and anatomical structures of the subject. The correct identification of the bony landmarks was of extreme importance to this study as incorrect identification of any structure may have lead to a negative assessment of SIJD. The structures to be identified on the subjects included: the iliac crests, anterior superior iliac spines (ASIS), greater trochanters, posterior superior iliac spines (PSIS), pubic tubercles, ischial tuberosities, gluteal folds, medial malleoli, inferior lateral angles of the sacrum (ILA), and the sacral sulcus (sacral base). These landmarks are of prime importance in identifying the presence of SIJD. When palpating the subject the examiners were looking for asymmetry of paired anatomical landmarks within the pelvic girdle and the lower limb. When examining the sacrum, the examiners were not only trying to identify any asymmetry in the horizontal plane, but also in the coronal plane. In the coronal or frontal plane, a variation in the depth of the structures is the key element as this gives an indication to the position of the sacrum and the role it may play in SIJD.

ACTIVE MOVEMENTS

Active movements allow the examiner the opportunity to assess the patient's willingness to move, the joint range of motion available, and the power involved in these movements. It also affords the examiner the opportunity to note which movements cause the pain and the subject's reaction to that pain. The active movements performed in this study included: forward flexion of the spine and hip, extension of the spine and hip,

rotation of the spine (left and right) (standing and sitting), side flexion of the spine (left and right), extension and side flexion of the spine (left and right), abduction of the hip, adduction of the hip, and medial and lateral rotation of the hip (Magee, 1987). The motion of both the spine and the hip can be affected by a sacroiliac lesion so that it was therefore necessary to include these active movements in the examination.

PASSIVE MOVEMENTS

In passive movements, the examiner puts the joint through a full range of motion, if possible, while the patient relaxes. Here the examiner is looking for any limitation of range (hypomobility) or an excess of range (hypermobility), if any pain is present, the cause of the limitation (e.g spasm), and the quality of the movement (Magee, 1987). The passive movements that were carried out during the examination for SIJD were in reality stress tests of the ligaments as well as the SIJ itself. For example, these movements included the gapping, approximation, and the straight leg raise clinical tests.

CLINICAL (SPECIAL) TESTS

Clinical (special) tests are used for each joint to help identify specific conditions, injuries, or disease when present. These tests are strongly suggestive of a condition, when positive, but do not necessarily rule out a condition when a negative result occurs (Magee, 1987). The clinical tests the subjects performed have been identified by many qualified therapists as those that will best identify a SIJD. As stated earlier, all of these tests fall into basically two categories: 1) palpation of bony landmarks with and without

measurement and 2) pain provocation tests (Walker, 1992). Generally speaking, the greater the number of tests that elicit a positive response, the more accurate the diagnosis of SIJD. The specific tests used in this study included:

Standing forward flexion test (Stand test): With the subject in a standing position, the examiner palpates the inferior slope of the PSIS as the patient bends forward in the motion of touching his toes, with the knees in full extension. The motion of the PSIS are compared to each other. A dysfunction is present if: both PSIS are not equally superiorly and anteriorly, and is labelled if one is more superior or anterior than the other. An abnormal motion will occur if this is present as the downward and backward glide of the two limbs of the SIJ is lost, and the innominate and sacrum move as one unit on the positive side. A false positive test can occur if the opposite hamstring is asymmetrical (shortened) or there is a true leg length difference. An observation of the thoracic and lumbar spines also occur with this test and any compensatory scoliosis or altered segmental rhythm is looked for. This test is used to identify any dysfunction at the symphysis pubis and the iliosacral joints. (Freer, 1993)

Stork Test A: With the subject standing, the investigator palpates the spinous process of the second sacral vertebrae and the PSIS on the right side. The patient is then asked to raise the right leg by bringing their right leg to their chest. Here the examiner follows the movement of innominate in relation to the sacrum. The normal movement is the PSIS moving inferiorly in relationship to the sacrum. The test is considered positive if the PSIS moves superiorly. The test is then repeated for the other side and the movements are compared. (Freer, 1993)

Stork Test B: Very similar to the Stork Test A except that the examiner now contacts the inferior edge of the crest of the sacrum and ischial tuberosity on each side. The examiner is following the movement of the innominate in relationship to the sacrum. Normal movement is the ischial tuberosity moving laterally and anteriorly. The test is positive if the ischial tuberosity moves superiorly. (The modified Stork B looks for exactly the same movement but involves the palpation of the spinous process of the second sacral vertebrae and the ischial tuberosity.) (Freer, 1993)

Sit Test (Piedallu's): The subject is asked to sit on a hard flat surface and the examiner palpates the PSIS, as the subject leans forward as far as possible. The examiner is looking for forward or superior movement at the PSIS. The heights of the PSIS are evaluated and if one PSIS is found to be lower, and upon forward flexion this PSIS becomes the higher one, the test is considered positive and it is that side that is affected. This indicates an abnormality in the torsion movement at the SIJ. (Magee, 1987)

Medial malleolar levels (supine and sitting): With the subject first in a supine position, the investigator palpates the inferior aspect of each medial malleolus and compares the level with the other. The examiner determines if they are equal or if one is shorter or longer than the other. The subject is then asked move into a sitting position while the investigator maintains contact with the malleoli. The examiner is looking for any difference in the levels of the malleoli in the two positions. A positive test is produced when an observable change in relative lower extremity lengths occurs. A negative test results when no change in length becomes apparent after changing positions. This test will help to determine the direction in which the innominate bone is tilted. With a posterior tilt the lower extremity appears short when lying supine, whereas with an anterior tilt the lower extremity will appear longer when lying supine. Upon sitting the short leg becomes the long one and the long leg the short one. (Cibulka, 1989)

Straight Leg Raise (SLR): With the subject in a supine position, the researcher passively flexes the hip with the knee extended through as full a ROM as possible. The presence of pain and it's location in the movement is being ascertained in this test. Pain that occurs after seventy degrees is indicative of joint pain, which may arise at the SIJ. (Magee, 1987)

Gapping: With the subject in a supine position, the examiner makes contact with the ASIS, and then pushes down and out to stress the anterior sacroiliac ligaments. The researcher is looking for the production of pain in the low back or gluteal region resulting in a positive test which may indicate a sprain of the anterior sacroiliac ligaments. (Magee, 1987)

Approximation: The subject is in a side lying position and the examiner contacts the iliac crest and downward pressure is applied. This movement is intended to elicit feelings of pressure or pain in the SIJ, indicating a possible sacroiliac lesion and/or a sprain of the posterior sacroiliac ligaments. This would constitute a positive finding. (Magee, 1987)

Patrick's Test (FABER): The subject is lying supine and the examiner places the foot of the test leg on the opposite knee. The examiner then lowers the test leg in abduction towards the table, which may produce pain in the SIJ indicating a positive test. (Magee, 1987)

Prone Knee Bend: With the subject in a prone position, the investigator contacts the bottom of the heel on both feet and looks for a difference in their levels. Maintaining contact with the heels, the knees are then flexed to 90° to see if any change in the level of the heels occur. A positive test ensues when an observable change occurs between the prone leg length and prone knee flexion. A negative test results when no observable change occurs between the two positions. (Cibulka et al, 1988)

These tests were performed in a variety of positions, and transpired in the order

as found in Table 3-1, to minimize positional changes by the subject and decrease testing time.

Table 3-1 Midget Player Evaluation Sheet

Midget Player Evaluation Sheet

Team:	**Name:**	**Shoot: L__ R__**	
Birthdate: / / D / M / Y	**Age:**	**Ht/Wt:**	**Position:**
ACTIVE MOVEMENTS (standing):			
Flexion:		Extension:	
Left Side bend:		Right S.B:	
Ext + S.B.L:		Ext + S.B.R:	
Rotation (ST):		Rotation (SIT):	
Palpation (standing):			
Iliac Crests:		ASIS:	
Greater Trochanters:		PSIS:	
Ischial Tuberosities:		Gluteal Folds:	
Clinical Tests (standing):			
Stand Test:		Stork Test A:	
Stork Test B:		Sit Test:	
Palpation (supine):			
Iliac Crests:		ASIS:	
Pubic Tubercles:		Medial Malleoli:	
Active Movements (lying):			
Hip Flexion:		Hip Extension:	
Hip Abduction:		Hip Adduction:	
Lat. Rotation:		Med. Rotation:	
Clinical Tests (supine):			
SLR:		Gapping:	
Medial Malleoli (Sit):		Patrick (FABER):	
Approximation:			
Palpation (prone):			
PSIS:		ILA:	
Sacral Sulcus:		Ischial Tuberosities:	
Clinical Tests (prone):			
Prone Knee Bend:			
Resisted Isometric Tests:		Hip Extension:	
Spine Flexion:		Hip Flexion	
Hip Abduction:		Hip Adduction:	

RESISTED ISOMETRIC TESTS

These tests are performed near the end of an examination and serve the purpose of identifying those areas of weakness exhibited by the subject. It requires an effort by the subject against the resistance being supplied by the examiner. In the assessment for SIJD, there are no specific muscles that act directly on the SIJ. However, contraction of adjacent muscles can stress the SIJ and the pubic symphysis (Magee, 1987). The resisted isometric tests utilized in this study included: forward flexion of the spine, flexion of the hip, abduction of the hip, adduction of the hip, and extension of the hip. These tests required the subject to be in supine, prone, and seated positions.

ASSESSMENT PROCEDURES TRAINING SESSION

To increase the inter-examiner agreement and to clarify procedures, the examiners completed a training session prior to data collection. The training session was conducted by examiner four, a physical therapist, who completed a Bachelor of Science degree in Physical Therapy (BSc. PT), and who possessed nine years of clinical experience. Examiner one possessed a Bachelor of Physical Education degree in Athletic Therapy (BPE, AT), who possessed one year of clinical experience. Examiner two possessed a Bachelor of Science degree in Physical Therapy (BSc.PT), and had seven years of clinical experience. Examiner three possessed a Bachelor of Physical Education degree in Athletic Therapy (BPE, AT) and had three years of clinical experience. Each examiner completed an assessment on a male volunteer while the others were present.

This instructional session was held to guarantee that uniform testing procedures would be utilized by all the examiners. At this time it was determined what would constitute a positive finding and what would be considered a negative result in the clinical tests, and how the findings were to be recorded on the evaluation sheet provided in Table 3-1. It was also determined that SIJD would be considered present in an athlete if at least two of the examiners obtained a positive response to at least three out of the following five tests: Stand Test, Sit Test, Gapping, Approximation, and the Prone Knee Bend.

ETHICAL CONSIDERATIONS

Prior to data collection ethical approval by The Faculty of Physical Education And Recreation Ethics Committee was received. Informed consent forms were provided to each volunteer athlete and his parent(s) or legal guardian. Information was provided on the forms which described that the study was for pure research and was not intended as a form of treatment for those with SIJD, the procedures to be followed, and that approximately one hour of time would be required. The risks of the study were identified and it was stated that the participant may withdraw from the study at any time, for any reason, without prejudice. The consent form also assured the athlete that confidentiality would be respected and that all information would be destroyed upon completion of the study. Finally the document encouraged the participant to pose any questions at any time to the investigator or the supervisor. (see Appendix A).

DATA COLLECTION AND ANALYSIS

The analyses of the information gathered by the examiners were completed by hand, by the principal investigator, with external verification from an independent source.

CHAPTER FOUR: THE QUESTION OF INTER-EXAMINER AGREEMENT

INTRODUCTION

As mentioned earlier in the review of the literature, the problem of inter-examiner agreement in the clinical tests for SIJD detection has surfaced in other studies. While Potter and Rothstein (1985) found 70% and 90% intertester reliability for the gapping and compression tests respectively, none of the other tests in their study exhibited more than 50% agreement. By conducting the assessment procedures training session in this study, it was hoped that satisfactory inter-examiner reliabilities would be found for the clinical tests used. However as explained in this chapter, an acceptable level of inter-examiner agreement was not realized. This then lead to a change in the sample. Altogether, 57 boys were members of the three hockey teams included in the sample. Out of these 57, 16 did not participate due to lack of interest or available time. This left a sample of 41 athletes.

INTER-EXAMINER AGREEMENT

As described in the previous chapter, each athlete was to be assessed separately by three examiners. However, due to time commitment, 16 athletes were assessed only by one, the primary investigator. Consequently, examination of the degree of inter-rater agreement was restricted to the sample consisting of the 25 athletes assessed by all three examiners.

Summarized in Table 4-1 are the number of athletes classified with or without SIJD by each examiner.

Table 4-1 Results By Examiners of SIJD Testing (n=25)

Examiner	Positive	Negative
One	12	13
Two	2	23
Three	7	18

Clearly the overall agreement is low. As shown, Examiner one found the greatest incidence of SIJD: 12 were diagnosed as positive. In contrast, Examiner two found only 2 athletes positive, Examiner three found 7. As mentioned beforehand, an agreement between two out of the three investigators was also required before a positive identification of SIJD could be concluded. Tables 4-2 to 4-4 show the results found by each investigator for each group, with POS indicating a positive result and NEG a negative result.

Table 4-2 Examiner Results For Group One (N=11)

Group One	Examiner One	Examiner Two	Examiner Three	Finding
1	POS	NEG	POS	POS
2	POS	NEG	NEG	NEG
3	NEG	NEG	NEG	NEG
4	NEG	NEG	NEG	NEG
5	POS	NEG	NEG	NEG
6	POS	POS	POS	POS
7	NEG	NEG	NEG	NEG
8	POS	NEG	NEG	NEG
9	NEG	NEG	POS	NEG
10	POS	NEG	POS	POS
11	NEG	NEG	NEG	NEG

Table 4-3 Examiner Results for Group Two (N=9)

Group Two	Examiner One	Examiner Two	Examiner Three	Finding
1	NEG	NEG	NEG	NEG
2	NEG	NEG	NEG	NEG
3	NEG	NEG	NEG	NEG
4	POS	NEG	NEG	NEG
5	POS	NEG	POS	POS
6	POS	NEG	POS	POS
7	NEG	NEG	NEG	NEG
8	NEG	NEG	POS	NEG
9	NEG	NEG	NEG	NEG

Table 4-4 Examiner Results for Group Three

Group Three	Examiner One	Examiner Two	Examiner Three	Finding
1	NEG	NEG	NEG	NEG
2	NEG	POS	NEG	NEG
3	POS	NEG	NEG	NEG
4	POS	NEG	NEG	NEG
5	POS	NEG	NEG	NEG

It can be seen from the previous tables that there was a lack of complete agreement among the three judges in 14 of the 25 athletes. This reveals a percentage of agreement between the judges of only 44% (11/25). As shown, examiner one agreed with the other two examiners more often than the other examiners did with themselves. Further, as shown, the first examiner found a positive result more frequently; on the

seven occasions where he disagreed with both of the other examiners, he diagnosed a positive finding. The percentages of agreement among the three examiners is summarized in Table 4-5.

Table 4-5 Summary of Inter-Examiner Agreement

	PERCENT AGREEMENT (N=25)			
Investigator Set	Group 1 (n=11)	Group 2 (n=9)	Group 3 (n=5)	Total (n=25)
1,2	6 (54%)	6 (67%)	1 (20%)	13 (52%)
1,3	7 (63%)	7 (78%)	2 (40%)	16 (64%)
2,3	8 (72%)	6 (67%)	4 (80%)	18 (72%)
1,2,3	5 (45%)	5 (55%)	1 (20%)	11 (44%)

The information contained in Table 4-5 reveals both strong and weak percentages of agreement. As mentioned above, the percentage of agreement among the three examiners was 44%. The strongest overall percentage of agreement occurred between examiners two and three, 72% (18/25). Examiners one and two agreed on only 13/25 or 52%, while one and three agreed on 16/25 or 64%.

Looking at the number of athletes each examiner found positive or negative for each clinical test also reveals a low percentage of agreement between judges. Table 4-6 shows this breakdown. Tests that are in bold type are the five used to determine if SIJD was present or absent.

Table 4-6 Clinical Tests Utilized to Identify SIJD (N=25)

Number of Positive Diagnoses

Invest.	**Stand**	Stork A	Stork B	**Sit**	SLR	**Gap.**	Med Mal	Patrick	**App**	**PK B**
One	19	3	2	20	2	1	10	1	2	13
Two	11	4	1	9	1	2	4	1	0	3
Three	13	9	0	13	2	1	11	2	0	13

Key: SLR=Straight Leg Raise, Gap.=Gapping, Med Mal.= Medial Malleoli, App.=Approximation, PKB=Prone Knee Bend

From this table one can notice that Examiner one found 76% (19/25) of the subjects to have a positive Stand test and 80% (20/25) to have a positive Sit test. These results were much higher than those found by either examiner two or three on these two tests. Examiner two found only 44% (11/25) and 36% (9/25) to be positive on the Stand and Sit tests respectively. Examiner three found 52% (13/25) for both tests. The only other tests which yielded a number of positive findings were the Medial Malleoli and Prone Knee Bend tests. However while examiners one and three found a similar number of athletes with positive results on the Medial malleoli test, 40% (10/25) and 44% (11/25), respectively, examiner two recorded only 16% (4/25). The pattern of positive findings for the Prone Knee Bend test is similar to that for the Medial Malleoli test. A result of 52% (13/25) of the athletes were diagnosed positively by both examiners one and three in contrast to 12% (3/25) by examiner two. The incidence of positive findings recorded by the examiners on the remaining tests were considerably lower, suggesting greater agreement where the athlete indicated or otherwise reacted negatively to the test.

After reviewing the information from Tables 4-1 to 4-6 it was deemed necessary to remove examiner one from the study as he seemed to be positively biased. By removing examiner one from the study a percentage of agreement of 72% between examiners two and three remained. Removing examiner one did not remove all problems with the data however. Seven instances of conflict between judges two and three still remained. Since an agreement between two of three judges was necessary before SIJD could be confirmed or rejected, a fourth examiner assessed the seven athletes about whom examiners two and three disagreed. Examiner four conducted the training session mentioned in Chapter 3.

Table 4-7 Examiner Four Results on Disagreements

Group#	Subject#	Examiner Two	Examiner Three	Examiner Four	Finding
One	1	NEG	POS	POS	POS
One	9	NEG	POS	NEG	NEG
One	10	NEG	POS	NEG	NEG
Two	5	NEG	POS	NEG	NEG
Two	6	NEG	POS	NEG	NEG
Two	8	NEG	POS	POS	POS
Three	2	POS	NEG	NEG	NEG

Table 4-7 illustrates that examiner four found two athletes positive and five negative while confirming the results of examiners two and three. Combining this finding with the previous findings of only one SIJD positive athlete by examiners two and three reveals that only 12% (3/25) of the 25 athletes could be considered to have SIJD.

Out of these three subjects, two were in group one while the other belonged to group two. There were no subjects from group three who were considered to have SIJD.

SUMMARY

The results from this study provided some useful yet disappointing information regarding SIJD. However, the material presented in this chapter increased our knowledge regarding the difficulties associated diagnosing SIJD with the clinical tests that were utilized in this study. Although the testing procedures were very well explained, the subjectivity of the tests used may have detracted from the results that may have been produced if these same tests were more objective, or if other objective tests could be used. Summarizing all the results led to the conclusion that of the 25 athletes who volunteered for this study, only three had a form of sacroiliac joint dysfunction.

CHAPTER FIVE: RESULTS AND DISCUSSION

INTRODUCTION

As the presence of low back pain is evident in almost every sport and occupation in Canada, the Midget Aged Male Hockey population was of great interest to this researcher for a number of reasons. Firstly, the researcher has been actively involved in competitive hockey for seventeen years, not only as a player, but also as a therapist. These experiences have familiarized this author with the aggressive nature of hockey and with the opportunity for injury in this sport, especially injuries to the back. Secondly it was at the Midget "AAA" level that this author began to experience his own sacroiliac joint dysfunction which caused him to wonder if this condition is present in the midget population of today. Finally, the author was actively involved with Midget "AAA" hockey as a therapist and was continuously dealing with complaints of low back pain. It was for these reasons that this study was conducted in the hopes of identifying the presence of sacroiliac joint dysfunction in the midget aged male hockey population.

Presented in this chapter is a discussion of the findings of a survey conducted to assess the incidence of SIJD in midget-aged male hockey players. This discussion is organized into 3 sections: Subject Selection and Recruitment, Physical Assessment, and Investigators.

SUBJECT SELECTION AND RECRUITMENT

The initial sample size consisted of 57 athletes from three different Alberta Midget Hockey League teams who volunteered to participate in the study. Of this number, 41 actually participated. Twenty-five of these athletes were assessed by all the examiners; the remaining 16 were examined only by examiner one because of the amount of time required for the assessment. However, as explained in the previous chapter, the assessments completed by Examiner one were deleted. Consequently the results of this study are based on the 25 athletes assessed by examiners two and three. The majority of the 25 players retained for the analysis came from the Edmonton Southside Athletic Club, with eighteen players taking part. The Leduc Midget team provided four players while the St. Albert Team provided only three individuals. These athletes formed three groups. Group One consisted of 11 Midget Aged Male Hockey Players who reported they experienced an episode of LBP during the 1993-94 season. Group Two comprised 9 players who although they have previously experienced LBP, they did not so during the 1993-94 season. Group Three contained five athletes who had never experienced LBP.

A description of the age, height, weight, and playing experience distributions of the athletes, is presented in Table 5-1.

Table 5-1 A Summary of Subject Characteristics (N=25)

Characteristics				
Group 1 n=11				
	Age (years)	Height (cm)	Weight (kg)	Experience (years)
Mean	16.6	180.4	77.6	10.8
S.D	0.5	4.9	6.7	1.2
Min.	16.3	172.7	71.0	9.0
Max	17.7	187.9	88.7	13.0
Group 2 n=9				
Mean	16.6	177.8	74.9	10.2
S.D	0.5	5.3	4.3	2.2
Min.	16.1	170.2	68.8	6.0
Max.	17.9	185.4	80.8	13.0
Group 3 n=5				
Mean	16.6	183.1	77.8	10.4
S.D	0 6	6.0	4.0	1.7
Min.	16.5	174.0	71.0	8.0
Max.	17.9	190.5	86.1	12.0
Total Group n=25				
Mean	16.6	180.0	76.7	10.5
S.D	0.5	5.4	5.7	5.0
Min.	16.1	170.2	68.8	6.0
Max.	17.9	190.5	88.7	13.0

As shown by the Total group statistics, the mean age of the players was 16.6 years, with the oldest subject being 17.9 years of age and the youngest 16.1 years. The mean height and weight in this group were 180.0 cm and 76.7 kg respectively, with a

maximum height of 190.5 (cm) and a maximum weight of 88.7 (kg). The mean number of years of playing experience was 10.5. As covered in Chapter 2, Gerberich et al (1987) found similar characteristics in their study on 251 High School Hockey Players. In that study the mean age of the players was 16.6 years, with a mean number of playing experience of only 8.8.

Table 5-2 Characteristics of LBP

Characteristic	Group 1 n=11	Group 2 n=9
Number of Episodes		
1-3	6	6
3-5	0	1
>5	5	2
Length of episodes		
1-3 days	6	4
4-7 days	3	3
7 or more	0	2
constant	2	0
Cause of LBP		
Body contact	5	4
Shooting	1	2
Conditioning	4	0
Falling	0	0
Unknown	1	3

Medical Treatment for LBP		
Doctor	1	4
Doctor and Physio	4	1
Physiotherapist	4	1
Chiropractor	1	2
No Treatment	1	1

As shown in Table 5-2, the majority of the athletes in both groups reported they experienced LBP one to three times, while 5 athletes in group one reported they had experienced LBP at least 5 times during the 1993-94 hockey season. The length of an episode of LBP lasted between 1-3 days for six of the athletes in group one and four of the athletes in group two. Three athletes in both groups indicated an episode would last from 4 days to a week. Two subjects in group one indicated they suffered constant LBP, both players reported that they could not recall a day where they did not suffer from LBP.

The majority of players from both groups, 5 in group one, 4 in group two, reported that their LBP began after some form of body contact. Four subjects in group 1 also mentioned conditioning drills as a cause of their LBP.

Turning to treatment, ten out of eleven players in group one sought some form of treatment, while in Group Two, eight of nine athletes did so. In contrast, the study completed by Jorgenson and Schmidt-Olsen (1986) revealed that 76 (38%) of 210 professional players did not receive any medical treatment.

Table 5-3 provides a description of each group in terms of the positions the athletes played.

Table 5-3 Number of Subjects by Position

Group#	Defence	Left Wing	Right Wing	Center	Goal	Total
One	6	0	2	2	1	11
Two	1	2	4	2	0	9
Three	0	3	0	0	2	5
Total	7	5	6	4	3	25

As shown, every position in hockey was represented by these athletes, with each group containing a majority of one position. Group one had 6 defencemen, group two had 4 right wings, and group three had three left wings and two goalies.

PHYSICAL ASSESSMENT

The findings of this study are based on a physical examination of the athletes which was designed to determine if SIJD was present in each athlete assessed. This assessment involved the components of palpation, active movements, passive movements, clinical tests, and resisted isometric tests. Before the testing began it was determined that SIJD would be considered present if any subject was found to elicit a positive response to at least three out of the following five tests: Stand Test, Sit Test, Gapping, Approximation, and the Prone Knee Bend. An agreement between two out of three judges was also required to confirm or disconfirm the presence of SIJD.

The physical assessment of these athletes revealed that only 3 (12%) of the 25

athletes were considered to be SIJD positive. In contrast, Mierau et al. (1984) found 135 (33.5%) of 403 elementary and secondary students to be SIJD positive; Gemmell and Jacobsen (1990) reported that 16 (19.3%) of 83 college students possessed a form of SIJD. Two of these athletes experienced LBP during the 1993-94 season (Group 1: Subjects 1 and 6); the third athlete diagnosed as SIJD positive experienced his LBP prior to the season, but not during the season. As each segment of this assessment played a vital role in the detection of SIJD, and will be discussed separately from one another. Furthermore, as this study was looking at the prevalence of SIJD in this sample population, only those 3 athletes who were found to be SIJD positive will be discussed.

PALPATION

The palpation component involved the direct physical examination of the subjects by the investigators. This evaluation was performed to provide the researcher with information about the pelvis and spine to estimate their involvement in the presence or absence of SIJD.

Subject #1, Group One, was assessed as having an anteriorly rotated innominate on the right side in combination with a right on left torsion of the sacrum. Subject #6, Group One had an anteriorly rotated innominate on the right as well as a unilateral anterior rotation of the sacrum on the left. Lastly, subject #8, Group Two, was exactly the same as subject #1; he also possessed an anteriorly rotated innominate on the left in combination with a right on left torsion of the sacrum. These three subjects all had a frequent form of SIJD which was described in Chapter One: SIJD that was caused by an

anteriorly rotated innominate. It may be recalled that the hypothesis of this study centered on the belief that as the innominate is forced to rotate anteriorly due the effects of bending forward, the SIJ are susceptible to injury as the anterior SIJ ligaments only offer scant protection. These three individuals exhibited this phenomena as all three suffered from a form of SIJD that was caused by the anterior rotation of a portion of their innominate complex.

ACTIVE MOVEMENTS

The active movements utilized in this study included motions of the spine and hip that may affect an SIJ problem. Their assessment is essential to identify the strength of the athlete, the willingness to move by the athlete, those motions which cause pain for the athlete, and to ascertain the location of this pain. The three SIJD positive individuals experienced problems with the movements of the spine. Subject #1, Group One, had pain elicited by flexion, extension, side bending (both directions), and extension with side bending which was located primarily on the right side (the side of his SIJD). Subject #6, Group One, suffered pain on flexion, extension, side bending, extension with side bending, and on sitting rotation. This subject's pain extended to the entire low back and buttocks, with the most intense pain being centralized on the side of his dysfunction, the right. Subject #8, Group Two, experienced pain only on extension and on the right side, where his SIJD was present. The active movements of the hip irritated the latter two subjects only slightly as pain was only felt on extension. Subject One, however, experienced pain on every motion of the hip, except hip adduction, with the pain

occurring primarily on the right side.

RESISTED MOVEMENTS

As previously mentioned in Chapter 3, in the assessment for SIJD there are no specific muscles that act directly on the SIJ. However, contraction of adjacent muscles can stress the SIJ and the pubic symphysis. It is therefore important that these resisted activities are included in a complete assessment for SIJD. Subject #1, Group One tested positively for pain production on every resisted movement which included spine flexion, hip flexion, hip adduction, hip abduction, and hip extension, all located on the right side. Subject #6, Group One, experienced pain and demonstrated weakness with spine flexion and hip flexion, hip abduction, and hip extension, all located on the right side. Subject #8, Group Two, experienced pain on the right side during spine flexion and hip flexion and hip abduction. These findings suggest that although there are no muscles that directly act on the SIJ, the adjacent musculature plays a role leading to pain production.

CLINICAL TESTS

As stated earlier, the clinical tests fall into two categories: 1. palpation of bony landmarks with and without measurement and 2. pain provocation tests. Ten of these tests were selected for use in this study and were reviewed in Chapter 3. These specific tests were chosen with the hopes of reproducing the results of other studies in which these tests were employed. Out of these ten tests five were designated as those which had been the most successful for other research. These tests were the: Stand, Sit,

Gapping, Approximation, and the Prone Knee Bend. This mixture of tests provided three from the motion palpation category (Stand, Sit, Prone Knee Bend) and two from the pain provocation category (Gapping, Approximation). It may be recalled from Chapter 2 that the motion palpation procedures have been found to be highly unreliable, whereas the pain provocation tests have provided greater reliability.

The motion palpation tests are subjective tests which require a decision to be made by the examiner while assessing each subject. This may have been a source of error as each investigator may have interpreted the findings differently. For the three motion procedures an evaluation of horizontal asymmetry was made between the paired anatomical landmarks to determine a positive or negative test. For the Stand test any superior movement of the PSIS as compared to the other side was to be reported as a positive result. The Sit test was similar as it also used the PSIS as the point of comparison, and again any superior movement of one PSIS as compared to the other, would be considered a positive test. The Prone Knee Bend involved an assessment between the heels of both feet in lying and flexed positions. Any difference between these the levels of the heels after changing positions, was considered a positive result. Looking back at Table 4-6 it can be seen how each examiner varied on each test. Investigator one was a fine example of the subjectivity of these tests as 19/25, and 20/25 subjects were found positive on the Stand and Sit tests respectively. The Gapping and Approximation tests provided no significant results as all investigators recorded no greater than two positive subjects for either test. Investigator one was the only researcher to elicit a positive approximation test (2 subjects) in any of the 25 study

volunteers. The other clinical tests utilized in this study, with the exception of the Medial Malleoli and Prone Knee Bend tests, did not reveal a large number of positive subjects.

To illustrate this subjectivity, a summary of the evaluation sheets for the three SIJD positive players are provided in Tables 5-4 to 5-6.

Table 5-4 Examiner Results on Subject #1, Group One
(N= negative, P= positive)

Invest.	**Stand**	Stork A	Stork B	**Sit**	SLR	**Gap.**	Med .Mal	Patrick	**App**	**PK B**
Two	N	N	N	N	P	N	N	N	N	N
Three	P	P	N	P	P	N	N	N	N	P
Four	P	P	N	P	N	N	P	N	N	P

Table 5-5 Examiner Results on Subject #8, Group Two
(N= negative, P= positive)

Invest.	**Stand**	Stork A	Stork B	**Sit**	SLR	**Gap.**	Med .Mal	Patrick	**App**	**PK B**
Two	P	N	N	N	N	N	N	N	N	N
Three	P	N	N	P	N	N	N	P	N	P
Four	P	P	P	P	N	N	N	P	N	P

Table 5-6 Examiner Results on Subject #6, Group One
* Examiner Four was not required to test this subject.
(N=negative, P= positive)

Invest.	**Stand**	Stork A	Stork B	**Sit**	SLR	**Gap.**	Med .Mal	Patrick	**App**	**PK B**
Two	P	N	N	P	N	N	N	N	N	P
Three	P	P	N	P	N	N	P	N	N	P
Four*	DID NOT TEST									

Reviewing these three tables, it can be seen that each subject tested positively on the Stand, Sit, and Prone Knee Bend. This was interpreted as a positive result as it satisfied the requirement of testing positive on three of the five qualifying tests. No SIJD positive subject was found to have a positive Gapping or Approximation test, the two tests that the literature indicated as being the most reliable.

INVESTIGATORS

The examination team that was utilized in this study was composed of two professionals from the field of Physical therapy and two professionals from the field of Athletic Therapy. This mixture provided an interesting blend of not only clinical experience, but also field experience, as Examiners One, Three, and Four had all been involved with Midget "AAA" hockey in the 1993-94 season. All of the examiners had some clinical experience in the analysis of SIJD: Examiner one - one year; Examiner two - seven years; Examiner three - three years; and Examiner four - nine years. The relative lack of experience may have been a determining factor in Examiner one's ability to identify the incidence of SIJD (see Chapter 4). With the motion palpation tests being highly subjective, the lack of experience exhibited by Examiner one may have contributed to his misinterpretation of the results of the movement palpation exams. This is witnessed by the number of subjects identified as positive on the Stand and Sit tests (Table 4-6) in the 25 players.

A second factor which may have played a role in the small number of SIJD

positive individuals being recognized was the palpation skills of the examiners. Walker (1992) reported that a systematic error of 7 to 14 millimetres and 12 to 24.5 millimetres was observed when physical therapists were asked to identify anatomical structures in one study. If the examiners inaccurately identified any of the anatomical landmarks of the spine and pelvis, this may have led to erroneous conclusions being reported. With each individual presenting a slightly different anatomical structure from the next, this factor may have affected the results.

Another potential source of error was the physical stature of both the athletes and examiners. As the average height of the athletes was 180.04 centimetres, the examiners may have had difficulties placing the players into the correct position. Examiner Two was susceptible to this problem as this investigator was a female of small stature. This problem may have been especially evident in the Prone Knee Bend, which required the examiner to move the subject's legs from an extended position to a flexed position. This movement demands that the examiner be able to maintain contact with the subject at all times while changing positions, usually requiring a long reach on the examiner's part. Examiner Two identified that this was a difficulty for herself and she would give her best possible effort to overcome this problem.

The final possible source of error which may have influenced the results is the belief each examiner had in the presence of SIJD. It was obvious that each examiner was concerned about this problem, as recognized by their volunteering, but did each examiner believe this condition to be present ? This dilemma may have affected each

examiner, but as the results indicate, Examiner one may have been especially prone to this problem. Examiner One had a distinct interest in this study which may have influenced him to be eager to identify positive subjects, leading to his expulsion from the study. The desire to find a large number of SIJD affected individuals may have affected his objectivity.

Even though there were areas of concern regarding the examiners, overall, the examiners performed very well in dealing with this complex task. Although the number of SIJD positive subjects was low, this study identified some important areas of concern for those interested in the identification of sacroiliac joint dysfunction.

CHAPTER SIX: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The purpose of this study was to identify the prevalence of sacroiliac joint dysfunction in midget-aged male hockey players as a potential cause of the low back pain from which they may suffer. Forty-one players 15 to 17 years of age, and from three different Alberta Midget Hockey League Teams, participated in this study.

Each volunteer athlete was asked to complete a questionnaire which allowed the athletes to be divided into three groups: Group One: Midget Aged Male Hockey Players who have experienced an episode of LBP in the 1993-94 season; Group Two: Midget Aged Male Hockey Players who have not experienced an episode of LBP in the 1993-94 season; and Group Three: Midget Aged Male Hockey Players who do not experience LBP. Group One contained eleven people, Group Two: nine, and Group Three: five. Each athlete was asked to attend one testing session lasting approximately one hour. This evaluation consisted of palpation, active movements, passive movements, resisted movements, and clinical tests used to identify SIJD. An athlete who was discovered as experiencing SIJD was required to be positive on at least three out of the following five clinical tests: Stand, Sit, Gapping, Approximation, and the Prone Knee Bend. Each athlete was reviewed by three examiners, and an agreement between two of the three examiners must have existed before SIJD could be confirmed or rejected.

Preliminary analysis of inter-examiner agreement revealed that the results from examiner one were somewhat different from the results for examiners two and three.

The percentages of agreement between examiner one and two, and one and three, respectively, were 52% and 64%. The percentage of agreement existing between investigators two and three was 72%. The percentage of agreement between all three examiners was 44%. Further, on two of the five designated exams, the Stand and Sit tests, examiner one recorded positive findings of 76% and 80%, in contrast to Examiner two (44% and 36%, respectively) and Examiner three (52% and 52%). Although the results of Examiner one were quite similar to the others on the remaining clinical tests, his tendency to identify positive rather than negative results led to the deletion of his findings. Given this, because of the time required for assessment, 16 subjects had been assessed only by Examiner one, thus these athletes were also excluded, yielding a final sample of 25 athletes.

Of the 25 athletes considered, only 3 were found to possess a form of SIJD. Two of the positive subjects presented SIJD caused by an anteriorly rotated innominate on the right in combination with a left on right torsion of the sacrum. The third positive subject also experienced an anterior rotated innominate on the right, however it existed with a unilateral anterior rotation of the sacrum on the left.

Physical contact in sports has been identified as a cause of low back pain (Fenety, 1989). Both football and ice hockey include physical contact in the rules of their sport. However, the contact these athletes engage in may be seen more as collisions rather than contact. When comparing hockey and football to other sports such as volleyball or field hockey, physical contact may be the element that predisposes these athletes to low back pain. The speed generated by the players in both hockey and football is great, and is

magnified in hockey due to the ice surface and equipment. As mentioned previously the forces generated by hockey players in skill completion and physical contact are very large. These forces have the potential to increase the severity of a Sacroiliac Joint Dysfunction as they not only increase the rapidity of any weight transfer, they also increase the amount of weight added to the upper trunk (DonTigny, 1990).

Although pregnancy has been identified as a cause of SIJD (Cibulka, 1989) which allows increased SIJ mobility in women, in this age group, increased mobility in the pelvis is possible due to non-ossification of the bones that form the pelvis. Lee (1989) reported that in the adolescent population the bones that form the pelvic complex only begin to ossify during puberty and may remain unossified until 25 years of age. This finding suggests that in those athletes where the ossification has not occurred, the potential for greater SIJ mobility exists which may both prevent or cause SIJD.

LIMITATIONS OF THIS STUDY

The completion of this study identified the following limitations which may have limited the results of this study. These limitations are:

1) low rate of cooperation/ participation of the subjects

2) inability due to lack of resources to assess all athletes with 3 investigators

3) examiner unreliability.

CONCLUSIONS

Each of the above limitations interfered with the collection of information regarding sacroiliac dysfunction. In light of these limitations, and based on the

information provided by this study, the following conclusions can be drawn:

1) The LBP from which the majority of subjects of this study suffer can not be attributed to SIJD.

2) SIJD does not exist in the hockey players in this study who reported no episodes of low back pain.

3) The subjectivity of the clinical tests used to identify SIJD, and the problem of low inter-examiner agreement lead to only 3 of 25 athletes identified as SIJD positive.

RECOMMENDATIONS

On the basis of the above study and conclusions, the following recommendations are presented regarding the evaluation for sacroiliac joint dysfunction in the field of Athletic Therapy:

1) Pre-season screening for athletes who suffer from LBP should include a thorough assessment for pelvic dysfunction and especially SIJD. Subjects who are identified as having SIJD should be monitored closely throughout the season.

2) Therapists should become aware of the correct procedures for treatment of this condition by enroling in a pelvic dysfunction course.

RECOMMENDATIONS FOR FURTHER STUDY

1) The identification of qualified investigators will enhance the quality of, and provide strength to, the data collected. These investigators should include professionals

from the fields of Athletic Therapy, Physical Therapy, and Chiropractic medicine.

2) During testing, discussion between investigators after the first athlete assessed should occur to remove any conflict between investigator results.

3) An effort should be made to objectify the current clinical tests designed to identify sacroiliac joint dysfunction.

4) A study which examines midget aged male hockey players who suffer from low back pain, over the course of a full season, might enhance recognition of SIJD as a cause of their LBP.

5) The assessment of individuals for pelvic dysfunction should occur, in a sample such as the one outlined in this study. Such a study may identify the contribution of pelvic dysfunction to low back pain.

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Appendix A

Informed Consent and Information Sheet

University of Alberta
Edmonton
Canada T6G 2H9

Department of
Physical Education and Sport Studies
P-421 Universiade Pavilion
Van Vliet Physical Education and Recreation Centre

Informed Consent for Research Study

The Incidence of Sacroiliac Joint Dysfunction Occurring in Midget Aged Male Hockey Players with Low Back Pain

Dear Parent and / or Guardian,

Low back pain is experienced by a large number of people in a variety of occupations. Recently many stars in the National Hockey League, such as Mario Lemieux, Paul Coffey and many others have fallen victim to this condition.

A number of researchers believe that low back pain is caused by activities that involve lifting , twisting, bending, and lowering associated with forward trunk flexion. Many of these movements can be found in the game of ice hockey suggesting a possible link to the low back pain being experienced by many players.

The study that your son or child is being asked to participate in will involve the assessment of the sacroiliac joints of their back through clinical appraisal. This evaluation will attempt to determine if the subject has sacroiliac joint dysfunction (SIJD) which may be a cause of the low back pain. This study is designed as pure research only and is not intended to be a form of treatment for those with sacroiliac joint dysfunction and associated low back pain. This research will be conducted under the supervision of Dr. Brian Fisher at the University of Alberta and was approved by the Faculty of Physical Education and Recreation Ethics Committee.

Participation in this study will require the completion of a questionnaire by the subjects and will include physical examination (palpation) of the bony landmarks of the

spine and pelvis. Active movements of the spine, such as flexion and extension, as well as a number of diagnostic tests will be performed to evaluate for SIJD under the supervision of the investigator. The assessment will be undertaken in standing, sitting and lying positions. This assessment will be performed by Sports Therapists and Physiotherapists. The tests used are non-invasive, and only require the subject to move throughout various positions to allow the appraisal of their sacroiliac joints. The testing procedure will take approximately twenty to thirty minutes. The total time required from the subject is approximately one hour. The only possible risk involved is the presence of low back pain during the evaluative procedures, which would be considered a positive finding.

The subject has the right to withdraw from the study at any time, for any reason, without prejudice.

All records will be kept confidential to the investigators and anonymity of the subjects will be guaranteed. Upon completion of the study, all information will be destroyed.

If concerns or question regarding the study arise prior to or during the study, please feel free to contact the investigator , Bob Langenhahn at 434-6669 (home) or 462-7880 (work), or Dr. Brian Fisher at 492-0580. (Please retain this copy for your own records)

Thank you for your co-operation.

Bob Langenhahn,BPE

University of Alberta
Edmonton
Canada T6G 2H9

Department of
Physical Education and Sport Studies
P-421 Universiade Pavilion
Van Vliet Physical Education and Recreation Centre

Informed Consent For Research Study

The Incidence of Sacroiliac Joint Dysfunction Occurring in Midget Aged Male Hockey Players with Low Back Pain

Parental Consent (Retained by Investigator)

I, _____, do hereby agree to allow my son / dependant to participate as a subject in the University of Alberta Graduate research project entitled,"The Incidence of Sacroiliac Joint Dysfunction In Midget Aged Male Hockey Players with Low Back Pain", to be conducted by Bob Langenhahn, BPE, MSc. candidate, under the supervision of Brian Fisher, PhD.

I acknowledge that the nature and purpose of the study, the required processes and the possible effects have been provided to me in writing by the investigator. I understand that participation in this study will require approximately one hour. Any and all questions arising have been answered to my satisfaction, and I know that I may ask any questions regarding the study at any time. I understand that participation in this study is not intended to be a form of remedial treatment. The investigator has assured me that all records will be kept confidential and that my permission is required to release any information that would reveal my son's identity. I have also been advised that upon completion of the study, all information will be destroyed. I have been advised that the subjects may withdraw from the study at any time, for any reason without prejudice.

_____	_____	_____
Parental signature	Date	Address
_____	_____	_____
Subject Signature	Date	Phone Number
_____	_____	
Supervisor	Investigator	

Appendix B

Back Injury Questionnaire

Back Injury Questionnaire

Name:_____ Age:____ Team:_____

1. a. How long have you played competitive ice hockey ?
(number of years) _____
b. How many consecutive seasons have you played, including this present one ?
_____
c. How many months did you train for this present season ?
_____

2. Do you train and compete in any sport other than ice hockey?
Yes ___ No ___ If yes, complete (a), (b)

a. Name of sport _____
b. Number of hours per week you train _____

3. Have you had any episodes of low back pain ? Yes___ No___
If yes, then complete the following.

a. How many episodes of low back pain have you had ? _____
b. How many days does an episode usually last ? _____
c. Where was the pain situated ?
low back ____
Buttock ____
both of the above ____
other (describe) _____
d. When you had the pain did you have difficulty getting comfortable to sit ___ stand ___ or sleep ___ ?
e. Did you ever experience low back pain during or shortly after an ice hockey practice or game ? Yes ___ No ___
f. Did the pain begin after:
contact with another player _____
taking a shot ____
(if so, what type ? eg. Slapshot) _____
conditioning drills _____
a fall on the ice or into the boards _____
g. Do you feel that back pain affected your performance during practice or a game?
Yes ___ No ___

4. Have you had an incident of low back pain that caused you to seek medical advice?
Yes ___ No ___
If yes, complete the following. If no, you are finished.

a. Did you see a Doctor ___ , Physiotherapist ___ , or a Chiropractor ___ ?
b. How many such incidents have you had ?
1993-94 Previous seasons ____
c. How many of these incidents have caused you to miss games or practices ?
_____