INJURIES IN THAI MALE NATIONAL SEPAKTAKRAW TEAM

KARUNA NERAPHONG

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Karuna Neraphong
.....
Miss Karuna Neraphong
Candidate

.....
Lect.Wattana Jalayondeja, Ph.D.
Major-advisor

Roongtiwa Vachalathiti
.....
Assoc.Prof.Roongtiwa Vachalathiti, Ph.D.
Co-advisor

.....
Prof.Liangchai Limlomwongse, Ph.D.
Dean
Faculty of Graduate Studies

Karnda Chaipackdee
.....
Assoc.Prof.Karnda Chaipackdee, M.Sc.
Chairman
Master of Science Programme
in Physiotherapy
Faculty of Medicine Siriraj Hospital

Thesis
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May 31, 2000

Karuna Neraphong
.....
Miss Karuna Neraphong
Candidate

.....
Lect.Wattana Jalayondeja, Ph.D.
Chairman

Roongtiwa Vachalathiti
.....
Assoc.Prof.Roongtiwa Vachalathiti, Ph.D.
Member

C Pavila.
.....
Mr.Chaiyasith Pavilas, M.Sc.
Member

.....
Prof.Liangchai Limlomwongse, Ph.D.
Dean
Faculty of Graduate Studies
Mahidol University

.....
Prof.Chanika Tuchinda, M.D.
Dean
Faculty of Medicine Siriraj Hospital
Mahidol University

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This study aimed to determine epidemiology of Sepaktakraw injuries such as incidence, severity, area, type and mechanism of injuries in 12 Thai male national Sepaktakraw athletes who participated in one international tournament. A questionnaire and other forms were used in this prospective study for collecting information of injuries during training and competition. The initial treatment, consequence and history of previous symptom were also recorded. Categories of injuries included 1) the injuries that make athlete require medical or physiotherapist attention and 2) injuries that have obvious tissue damage. Time loss period from sport activities produced by the injuries was used to determine severity level of those injuries.

At the end of this tournament, 53 injuries were recorded during 3903.5 hours. Incidence was 13.58 injuries per 1,000 player-hour. Forty-six injuries were found during training (11.90 injuries per 1,000 player-hour) and 7 injuries during competitions (177.22 injuries per 1,000 player-hour). Twenty-five of 53 injuries had previous symptoms. Nineteen of all 25 injuries had those symptoms occasionally and all the time. There were 10 injuries in feeders (9.88 injuries per 1,000 player-hour), 14 injuries in servers (10.55 injuries per 1,000 player-hour) and 29 injuries in attackers (18.54 injuries per 1,000 player-hour). The majority of injuries did not disturb sport activities or no time loss. The top four sites of injuries were at ankle, knee, thigh and hip. Strain, sprain and spasm were common in this study. There were 33 acute injuries and 20 overuse injuries. For 33 acute injuries, 14 injuries were found during attacking, 4 injuries during serving, 4 injuries during blocking, 2 injuries during feeding, 8 injuries during other activities and 1 injury, which could not be specified. Aggressive landing, swinging and fluttering in the air were the majority of movement that caused injuries

From the result of this study, this athlete group had a high incidence of injuries (13.58 injuries per 1,000 player-hour). The aggressive activities of Sepaktakraw could produce many injuries especially, at lower extremities, although those injuries were usually not severe. Muscle and tendon injuries were common in Sepaktakraw activities. The possible factors related to number of injuries might be aggressive activities, incomplete healing and education of injury management. For further study, the other risk factors such as supportive devices, psychology effect were interesting to investigate. Moreover, preventive intervention would also be experimentally proceeded to reduce amount and severity of injuries in this athlete group.

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การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาระบาดวิทยาของการบาดเจ็บในนักกีฬาเซปักตะกร้อชายทีมชาติไทยจำนวน 12 คน ที่เข้าร่วมการฝึกซ้อมและการแข่งขันในรายการระดับระหว่างประเทศจำนวน 1 รายการ ทำการเก็บข้อมูลของการบาดเจ็บได้แก่ อุบัติการณ์, ความรุนแรง, ตำแหน่ง, ชนิด และกลไกการบาดเจ็บ โดยใช้แบบสอบถามและแบบบันทึกข้อมูล ทำการศึกษาแบบล่วงหน้า นอกจากนี้ยังรวบรวมข้อมูลเกี่ยวกับการรักษาเบื้องต้น ประวัติอาการบาดเจ็บในอดีต และผลภายหลังได้รับบาดเจ็บ โดยการบาดเจ็บที่จะถูกบันทึกนั้นจะต้องมีเกณฑ์ดังนี้ 1) ต้องการการดูแลจากแพทย์หรือนักกายภาพบำบัด และ 2) เกิดการทำลายของเนื้อเยื่อ การบาดเจ็บเหล่านี้อาจทำให้ขาดการฝึกซ้อมหรือการแข่งขัน ซึ่งระยะเวลาดังกล่าวจะหมายถึงความรุนแรงของการบาดเจ็บในการศึกษาครั้งนี้

ภายหลังสิ้นสุดการแข่งขัน พบการบาดเจ็บจำนวน 53 การบาดเจ็บในช่วงระยะเวลา 3903.5 ชั่วโมง ค่าอุบัติการณ์เท่ากับ 13.58 การบาดเจ็บต่อ1,000 ชั่วโมงกิจกรรมกีฬา พบ 46 การบาดเจ็บระหว่างการฝึกซ้อม หรือ 11.90 การบาดเจ็บต่อ 1,000 ชั่วโมงกิจกรรมกีฬา และ 7 การบาดเจ็บระหว่างการแข่งขัน หรือ 177.22 การบาดเจ็บต่อ 1,000 ชั่วโมงกิจกรรมกีฬา นอกจากนี้พบ19 จาก 25 การบาดเจ็บที่มีประวัติอาการบาดเจ็บเก่า ยังคงมีอาการระหว่างการเกิดการบาดเจ็บในการศึกษาครั้งนี้ พบ 10 การบาดเจ็บในตัวชง 14 การบาดเจ็บในตัวเสิร์ฟ และ 29 การบาดเจ็บในตัวฟาด พบ 40 จาก 53 การบาดเจ็บไม่ก่อให้เกิดการขาดการฝึกซ้อมหรือการแข่งขัน การบาดเจ็บส่วนใหญ่พบที่ ข้อเท้า เข่า ต้นขา และสะโพก นอกจากนี้ยังพบการบาดเจ็บแบบเฉียบพลัน จำนวน 33 การบาดเจ็บและการบาดเจ็บแบบการใช้งานมากเกินไปจำนวน 20 การบาดเจ็บ จาก 33 การบาดเจ็บแบบเฉียบพลัน มีการบาดเจ็บระหว่างการฟาด 14 การบาดเจ็บ ระหว่างการเสิร์ฟ 4 การบาดเจ็บ ระหว่างการบล็อค 4 การบาดเจ็บ ระหว่างการชง 2 การบาดเจ็บ ระหว่างกิจกรรมอื่นที่ไม่ใช่การเล่นเซปักตะกร้อ 8 การบาดเจ็บ และ 1 การบาดเจ็บที่ไม่สามารถระบุกิจกรรมได้ การลงสู่พื้น การสะบัดอย่างรุนแรงเป็นกิจกรรมที่มักก่อให้เกิดการบาดเจ็บเป็นส่วนใหญ่

สรุปผลการศึกษา การบาดเจ็บที่เกิดขึ้นมีจำนวนมาก โดยมีปัจจัยที่ทำให้เกิดการบาดเจ็บคือ ลักษณะการเล่นหรือกิจกรรมที่รุนแรง นอกจากนี้การบาดเจ็บที่ไม่หายสนิท อาจนำไปสู่การบาดเจ็บซ้ำ การบาดเจ็บมักเกิดที่อวัยวะส่วนล่างของร่างกาย โดยเกิดที่กล้ามเนื้อและเอ็นกล้ามเนื้อ เป็นที่น่าสนใจอย่างยิ่งในการศึกษาปัจจัยเสี่ยงอื่น ๆ ที่มีผลต่อการบาดเจ็บในนักกีฬาเซปักตะกร้อ และการหาวิธีป้องกันการบาดเจ็บ เพื่อลดจำนวนและความรุนแรงของการบาดเจ็บในการศึกษาครั้งต่อไป

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CHAPTER I

INTRODUCTION

Injury is one of the major problems in sport activities. It can occur not only in professional athletes but also in amateurs and anyone who plays sport. It takes some times and money for injured persons to return to their pre-injury abilities and performances. In addition, some athletes might lose their opportunities to get medals because of their injuries. Prevention is important to decrease sport injuries. Prevention strategies are based on epidemiological information such as incidence, area, severity, type and mechanism of injuries. However, the epidemiological information is specific for each sport (1-4).

Sepaktakraw is one of the popular sports in Thailand and also in Asian countries. Thai national team is one of the success teams in Asia. This team was the winner in 13th Asian Games and the second place in 11th and 12th Asian Games. Thai national team was also the winner in SEA Games for many times. In order to be the greatest team, athletes would have a great performance and less injury. To prevent injury, epidemiological information is essential to establish preventive strategies of Sepaktakraw injuries. However, there are few reports related to injuries in Sepaktakraw in Thailand. Sport Authority of Thailand (SAT) reported number of Sepaktakraw-related injuries whom consulted at Sport Clinic at Hua Mak Sport Complex (5,6). There were 91 injuries from 1983 to 1986, 10 injuries in 1995, 6 injuries in 1996 and 50 injuries in 1997. However, the data did not determine the detail

of injuries of the national team. Although this clinic served national athletes, all injured athletes were not treated at this Sport Clinic. Athletes could go to other facilities such as hospital or other sport clinics. In addition, SAT did not report epidemiological information in detail such as incidence, severity and mechanism of injuries. Therefore, the present study investigated the epidemiology of injuries in Sepaktakraw athletes in more detail.

The preventive strategies in sports consist of four steps (7). The first step is to determine characterization of sport injuries in terms of incidence and severity. Severity of injuries could be determined in terms of time loss. The area and type of injuries are also determined in this step. The second step is to identify etiology and mechanism of sport injuries. The etiology of injuries can be established by risk factors, which divided into 2 categories; internal and external risk factors (7,8). The internal risk factors include age, sex, previous injury, physical fitness, body structure and psychological factors. The external factors include sports-related factors such as venue, equipment, weather condition and training strategies. In the second step, not only risk factors are concerned but mechanism of injury is also defined. The actual mechanism could cause with the amount of stress, which imposed to the human body during a sport situation and leaded to tissue damage (9). The third step is to introduce the preventive measure which based-on the etiology and mechanism of injury in the second step. The fourth step is to evaluate the preventive measures by injury reinvestigation as in the first step.

There are still no studies of injury in Sepaktakraw, which report incidence, severity, etiology and mechanism of injuries in Thai national athletes. There is a report by SAT that determined number, type, and area of injuries in Thai national Sepaktakraw athletes. However, the incidence related to exposure time and severity in terms of time loss from sport participation was not determined. The mechanism and etiology of injuries were still not described.

Therefore, the present study established incidence, area, severity in terms of time loss, type and mechanism of injury. This study also estimated and explored etiology of injury by describing possible risk factors in Thai male national Sepaktakraw team.

Purpose of the Study

General Objective

To determine the epidemiological information of sport injury in Thai male national Sepaktakraw athletes

Specific Objectives

1 To determine incidence of injuries in Thai male national Sepaktakraw athletes

2 To determine severity of injuries in Thai male national Sepaktakraw athletes

3 To determine injured areas in Thai male national Sepaktakraw athletes

4 To determine types of injuries in Thai male national Sepaktakraw athletes

5 To determine possible mechanisms of injuries in Thai male national Sepaktakraw athletes

Scope of the Study

This study investigated the epidemiological information; incidence, severity, area, type and mechanisms of injuries in Thai male national Sepaktakraw athletes in one international tournament.

Parameters

1 Incidence of injuries

2 Severity of injuries

3 Area of injuries

4 Type of injuries

5 Mechanism of injuries

Definition of Terms

1. Incidence of injuries: a number of sport injuries occurring in a particular period divided by the total number of sportsmen at the start of the period (population at risk) (7).
2. Severity of injuries: unit of time loss from sport activities or program participation.
3. Session periods: time period (hours) of a training (practice) or a competition during the time of this study.
4. Athlete's session hours: the sum of session periods (hours) which an athlete participates in training and competition during the time of this study.
5. Participation hours: the sum of all athletes' session hours (hours)
6. Previous symptom: abnormal symptom, which occurred before the present injury.

Advantages of the Study

The incidence and severity of injuries in Thai male national Sepaktakraw team were established. Position in team, mechanisms and sport activities related to injuries were determined. The cause and risk factors were also estimated. The information would be a guideline for coaches and athletes to develop preventive strategies and to adapt athletes' techniques during practice or competition in order to prevent injuries from Sepaktakraw. The result of this study could be applied in Thai national team and leads to less injury. Therefore, this would contribute Thai male national Sepaktakraw team to remain the greatest team in Asia.

CHAPTER II

LITERATURE REVIEW

2.1 Epidemiology of Sport Injury

Prevention is one way to decrease sport injuries (7,8). The goal of the Wold Health Organization is the reduction of sports injuries, in extent as well as in severity. Mechelen in 1992 introduced a plan, a sequence of prevention, which consists of four steps (7). First step was to acquire data concerning the nature, extent and severity of sports injuries. Second step was to identify the etiology factors involved in sport injury. Third step was to apply one or more measures, based on identified etiologic factors to prevent sport injuries or reduce their severity. Forth step was to evaluate the applied preventive measures in order to compare the incidence and severity before and after the intervention.

Sport injuries were determined by epidemiological studies (10-14). An epidemiological study could describe injury profile, dimension, severity, nature and extent of sport injuries in term of incidence and severity. Epidemiology is defined as the medical science dealing with the occurrence, causes and prevention diseases (3,12). The researchers would seek to find factors associated with the onset of disease and to make recommendations for control and prevention by identifying the patterns of injury occurrence. Powell (12) described many benefits of epidemiological study as following.

1. It could serve as the focal point for particular problems associated with injury and illness.
2. It could measure long-range trend to the frequency and severity of injury and illness.
3. Other researcher effort could be served by providing baseline information regarding injury and illness.
4. It could help to provide insight into and identify clues to the reasons for injury occurrence.
5. Epidemiological information could use to establish priorities for preventive actions.
6. The epidemiologist could assist in the evaluation of the effectiveness of preventive measures by maintaining the information database.
7. The research instrument could serve as the foundation for the permanent record-keeping procedure necessary to continually monitor injury and illness.

The epidemiological study was separated into 2 types as descriptive and analytic epidemiology (3,11). Descriptive epidemiology identifies the incidence, type and severity of injuries occurring in specific population. After the injury described, analytic epidemiology would search for risk factors which were affecting the occurrence of injury. Epidemiological information in many sports which have activities like Sepaktakraw such as soccer, volleyball and gymnastics were studied by many investigations (10,13,15-21) as shown in table 2.1, 2.2 and 2.3. Numbers of injuries in those sports were different. This is because the methods of data collection

were different. Definition of injury, injury profile in each sport, group of participant and also methodology of recording influenced number of injuries in each study. Therefore, the comparison among the reports for each sport is difficult. There were few studies (5,6) related to Sepaktakraw in Thai athletes. Most of these studies did not describe the results in detail such as incidence and severity. In other words, Sepaktakraw injuries just come in attention of researchers few years ago. Therefore, the incidence, injury profile and severity of injury in Sepaktakraw would be determined appropriately in descriptive epidemiological study.

Table 2.1 Number of injuries in soccer

Author	Source of Data	Number of Injuries	Incidence	Severity
Hoy et al (15)	Injury record at emergency department in hospital for one year	715 injuries on population-based in one year	_	314 mild injuries 332 moderate injuries 63 severe injuries
Neilsen and Yde (10)	Injury record of soccer club filled by coaches for 11 months	109 injuries	11.9-18.5 per player hour	46% absent<1 wk 19% absent1-4 wk 35% absent>4 wk
Putukian et al (16)	A 3 days tournament met at side line and training room recorded by athlete trainers	-38 injuries with time lost -41 injuries with no time lost	4.44 per 100 player-hour	Mild <1 wk 25 injuries Moderate 1-4 wk 6 injuries Severe >4 wk 7 injuries
Delee and Famey (17)	A high school football season by athlete trainers in 100 schools	2228 injuries	0.506 injuries per athlete per year	_

Table 2.2 Number of injuries in volleyball

Author	Source of Data	Number of Injuries	Incidence	Severity
Bahr et al(18)	A national volleyball league recorded by coach	_	0.9±0.12 per 1000 player hour	Most injuries were mild followed by moderate injuries
Schefle et al(13)	A national tournament; 6days=7812 player hours recorded by on-site medical team	157 injuries	1.97 per hour of player	85 injuries or 0.23 per hour of player absent 1< day

Table 2.3 Number of injuries in gymnastics

Author	Source of data	Number of Injuries	Incidence	Severity
Sands et al(19)	5 years competitions of women's gymnastics: each athlete answer question posed by computer program every training day	3963 injuries with 509 new injuries	_	_
Wadley and Albright (20)	4 year-period of numbers of division I women's gymnastic team, recorded by athlete trainer	106 injuries (26 athletes)	_	Mean time lost: -return to athlete activity=13.18 day (±38.59) -return to full participation=30.87 (±60.80)day -free symptom=49.15 (±74.27)day

Table 2.3 Number of injuries in gymnastics (cont.)

Author	Source of Data	Number of Injuries	Incidence	Severity
Frank and Edwa (21)	7 months (1 season) 15 clubs, recorded by members of the clubs (2,553 participants)	62 injuries	2.4 per 100 participants (5.3/100 competitors) (0.7/100 beginners)	_

Sepaktakraw is non-contact sport. Strain, sprain, inflammation, avulsion fracture and overuse syndrome are often found in non-contact sport. The mechanisms of injuries in non-contact sport usually are falling from height, tumbling, vaulting, rapidly twisting and landing. Knee and ankle injuries are commonly occurred when landing. In volleyball, most causes of ankle inversion injuries are landing on opponent's foot in the net zone (18). Moreover, in gymnastics, falling from high level equipment such as bar, balance beam and uneven bar (in women) induce sprain and strain at knee and ankle (19,20,21). Repetitive hyperdorsiflexion when vaulting takeoffs, backward tumbling and landing usually caused chronic irritation of soft tissues and articular surface at talotibial joint. This irritation causes impingement as overuse injury. Stress fracture of fibular or tibia usually occurs when repetitive motion such as running, jumping, landing. Moreover, most mechanisms of back sprain and strain in gymnastics were repetitive hyperextension of lumbar spine compound by impact loading, tumbling and landing from high level equipment.

Aggressive activities in Sepaktakraw would produce many injuries, although this sport is a non-contact sport. Landing, rapidly twisting, spinning, tumbling, flipping, rapidly jumping, offensively bounding movement are often found in

Sepaktakraw. These activities used head, neck, trunk, shoulder, wrist, hand, hip, knee, ankle and foot. Moreover, these activities usually are high repetitive and need hypermobility of joints and forceful contraction of muscles. Therefore, these activities may cause common injuries as other non-contact sports like volleyball and gymnastics. Unfortunately, there were few reports of Sepaktakraw-related injury in Thailand.

Sport Authority of Thailand (SAT) reported ninety-one injuries in Sepaktakraw between 1983-1986 (5), ten injuries in 1995, six injuries in 1996 and fifty injuries in 1997 (6). Majority of injuries was at knee followed by ankle, back and thigh. SAT detected sport injuries when the athletes needed treatment and walked into the sport clinic. Number of reported injuries increased from six injuries in 1996 to fifty injuries in 1997, because in 1997 the Thai national team had trained at the Hua Mak Sport Complex, which was near the sport clinic. In 1996, they were trained at National Stadium that was far from the clinic. Therefore, there are still no accurate numbers of injuries in Thai national team. In addition, severity, mechanism and incidence of injuries are still not established. Types of injuries in 1995-1997 were also not reported. Thus, the exact number of injuries in Sepaktakraw would be more than SAT's report.

In Thailand, players of Sepaktakraw are classified in many levels such as school level, national level and international level. This also does not represent any study, which explored the details of Sepaktakraw-related injury data. It is interesting to exhibit epidemiology of injuries in Sepaktakraw. Moreover, aggressive activities and long time to expose the injuries could produce extremely and severe injuries in the

Sepaktakraw players. Thai male national had higher intensive training and competition than other levels of Sepaktakraw. Thai male national team is the highest risk group. Therefore, this study investigated injury data in Thai male national team.

In order to conduct an epidemiology study in sports, injury definitions had to be defined. Moreover, the calculation of incidence should be specified. This incidence is calculated from number of injuries that are counted by the investigators and divided by number of participation hours. To study in detail of epidemiology of sport injuries, severity, area and type of injuries also have to be determined.

2.2 Definition of Injury

Definition of injuries would describe, indicate and select sport injuries in study. Injury is often defined as one, which alters athletic performance and produces a time loss from participation (22). Some definitions, such as using time lost or medical attention could not include all of injuries, especially minor injuries that often meet on field as generally injuries. The difference pain threshold or disabilities levels would cause athletes to differently miss practice or playing (4,22). However, this different was difficult to control. On the other hand, the overestimate bias would include blisters or abrasion in term of minor injuries. This condition was rarely affecting the ability of athletes to compete. The athletes would leave the field or over-dramatize an injury to make referee bias of decision in their favor. Definition of injury is clearly exhibited and identified before collecting data. Therefore, definition influences on collecting number of sport injuries.

The variables of creating an injury definition are as following (22):

1. Time lost from athlete participation (23): The injury is defined as the inability of an athlete to return to the field of play on either the same day or the day following an injury. There are 3 factors that must be clarified in using this definition.

1.1 This definition assumes that all players respond to an injury in a similar manner that is no scientific way to assess. Because of tolerance, performance and also pain threshold in athletes are different. The same injury in two different athletes would cause one player to stop sport activities while another would experience not produce impairment in performance (16).

1.2 The second bias is individual standard decision to allow athlete participate in sport. Some injuries in one sport could be allowed to participation whereas some injuries would not be. Different physicians or physiotherapists would make different decisions making.

1.3 Sensitivity of reportable injury is depended on time stated. Some studies defined as injury which make player unable to return to play on the same day (10,16,17,20,21,23), other study extends the time to 24 hours period following the injury (19). The latter definition excludes more minor injuries such as contusion that may allow athletes to participate in same day, but these injuries would still bother athlete. Therefore, this definition is used to define only when the investigator realizes that this is a highly subjective definition which may produce bias in data collection and conclusion.

2. Medical attention: Medical attention is defined as any treatment given by a physician or physiotherapist or trainer (22). This definition will exclude lumps, bumps, bruise, scratches, abrasion and overuse injuries. Only part of total sports injury

problem is revealed as 'tip-of-the-iceberg' (7). In addition, this definition could not be used in sport training or team which physicians or examiners are absent. There will be missing reportable injuries. This definition should base on a concept of health by relation with time loss definition than that customary in standard medicine.

3 Anatomical "tissue" diagnosis. Tissue diagnosis is the most objective method to determine whether an injury occurring (22). This definition excludes psychological factors such as self-extreme and personal perception, which influence the definition of missing participation.

2.3 Incidence of Injuries

Incidence rate of sport injuries is defined as a number of new sport injuries during a particular period divided by the total number of sportsmen at the starting period (population at risk) or divided by time of participation (time at risk) (7). There would have some problems, which lies in the way of calculation. The numbers of injuries in one athlete could be exhibited when the incidence is calculated from number of injuries divided by participation time. However, the rate which not take accounting of exposure period could not indicate the true extent of the problem, nor could identify incidence rates for different sports to properly compare (4,7,24). Because of the rate, which is per time unit could show the occurrence of injuries by length of sport participation time. Moreover, different practices or sport events would have different time periods, it will be better to calculate the incidence of sport injuries in relation to exposure small time unit. That rate which divided by participation time will also enable to compare in different sports and different sportspersons more fairly

in this respect. For this purpose, injury incidence is usually expressed as the number of injuries per 1000 hours of sport participation (3,25).

$$\text{The incidence rate} = \frac{\text{Number of injuries x 1000 hours}}{\text{Participation hours}}$$

The participation time is used to demonstrate the injury exposed of participants. The calculation of participation time for incidence was affected by method of counting and recording. There is proper counting of participation time which the method of counting could exhibit the exposure time of participants. There are 2 kind of counting the exposure time; estimated and absolutely counting. The estimation is produced from number of participants multiplied by average game period. The absolutely counting is summed the true period that athletes participated. Retrospective study often estimated time-related explore. This estimation was not absolute exposure time, which would be recall bias. Retrospective study usually found lower incidence whereas prospective study determined higher incidence.

In addition, number of injuries is amount of injuries in all participants. Number of injuries not only depends on the effect of definition of injury, but also be influenced by period of time. The prospective study of brief tournaments would show very high incidence; mainly because of extremely high intensity of activity during few days (10,13). On the other hands, short tournament could produce low incident because of the several substitutions in each team. The risk to injury would be decreased while the number of player minute decrease (16). This safe administration was promoted in most of sport teams.

The incidence of injury depends on the characteristic of participation group. In higher level of competition, the concentration of competition is usually higher intensive than the lower level. The intensity of games in an international tournament is expected to be greater (13,24,25) because of the higher activity levels (10). Therefore, the higher level would lead to more injuries (10,26). However, professional or club level had lower incidence than school level (1,2). Because the club's players not reported their injuries to the club. The club's pressure on players was the main affected on injury record. This would be reason why many players continued the game or practice although they had injuries. For this reason, these players are leading to a risk of prolonging and duration of injuries.

2.4 Severity of Injuries

The basis of 6 criteria of severity can be described as nature of sport injuries, duration and nature of tournament, sporting time lost, working time lost, permanent damage and cost of sport injuries (7).

2.4.1 Nature of sport injury

Recording of the nature of sport injuries can identify the sport with relatively serious injuries. By the categories of medical diagnosis, the nature of sport injury is defined as sprain, strain, contusion, abrasion, laceration, infection or inflammation and concussion (7). The nature of sport injury usually requires medical attention (medical or otherwise). However, some common injuries such as abrasion which not requiring medical treatment. These minor injuries are not considered in

medical category and not reported. Coach or trainers who select injuries to consult medical attention could not report some minor injuries, if they can manage these minor injuries by themselves. Moreover, these minor injuries would not be reported, if the collecting injuries were done at hospital. Therefore, assessing for severity of injury needs to know where and who examines the injuries.

2.4.2 Duration and nature of treatment

Mechelen and et al in 1992 (7) suggested that duration and nature of treatment could determine the severity of injury more precisely. The numbers of visiting the medical facilities and treatment of each injury are recorded. If any injury needs hospitalization, total days stayed in hospital are registered. This category can also be estimated the cost of medical treatment and the effectiveness of different therapists for similar injuries.

2.4.3 Sport time lost

Life individuals are regarded as healthy, if they can do their daily work. Athletes are not fully recovered unless they can take part in their sport (training session or match). It is important for sportsperson to enable to take up their sport again as soon as possible after injury. National Athletic Injury Registration System (NAIRS) in USA uses this concept to identify sport injury and severity of injury. Reportable sport injury is defined as one that limits athletic participation for at least the day after the day of onset (27). NAIRS also identified severity of injuries according to the length of incapacitation, into 3 levels as minor (1 to 7 days), moderate (8 to 21 days) and serious (over 21 days or permanent damage). However, the NAIRS classification

of severity would not be used overall injuries, if injuries could not disturb athlete's activities more than one day (3,20).

The cessation or reduction of training is usually used as an indication of severity, although this cessation is influenced by psychological factors. Therefore, the sporting time lost is often related with a) the number of treatment, b) injury site and c) medical diagnosis to reduce dramatize or psychological problem.

2.4.4 Working time lost

The working time lost is one of the indicators of the financial consequences of sport injuries to society. Generally, this indicator is considered from official statistics such as the Industrial Insurance Administration Office and Insurance boards, many people, including students, old age pensioners, the disabled, the unemployed, the self-employ, housewives and civil servants.

2.4.5 Permanent damage

Although the majority of sport injuries heal without permanent disability, some severe injuries of NAIRS classification such as fracture, ligament, tendon and intra-articular injury, spinal injury and eye injury can leave permanent damage (residual symptoms). The permanent damages which cause permanent disabilities or death is reducing the individual's capacity for work or sporting activities. After the residual symptoms are reduced, the injured athletes may modify their level of sport activities.

2.4.6 Cost of sport injuries

The cost of sport injuries can be calculated by the expression of the above mentioned 5 categories of sport injuries in economic and social terms. The economic costs are divided into direct such as cost of medical treatment and indirect cost such as the loss of productivity and morbidity level (7).

The social costs are classified as quantifiable and unquantifiable. Quantifiable costs are insurance and legal expenses. Unquantfiable costs are the harmful effects of a sport injury on the psychosocial life of the individual or his family such as owing to economic dependence, loss of social status or position or social isolation. However, these costs are quantifiable which only extend the quantifiable quality of life.

The severity of injuries is important aspect to identify the extent of the sports injury problems. The selection for one or more indicators of severity should be based on specific research questions. It also needs to enhance the comparability of research data.

2.5 Type of Injuries

Type of injuries is used to establish the type of damaged tissue and applied force at injured area. Mechelen et al in 1992 (7) divided nature of injury or type of injury as sprain, strain, contusion, abrasion, laceration, infection or inflammation and concussion. In addition, types of injuries which may be found in sport are tendinitis, contusion, muscle spasm, cramp, delayed muscle soreness syndrome, bursitis,

subluxation, joint dislocation, synovitis, fracture and stress fracture (2,16,21,23,24,25,28,29,30).

2.5.1 Strain

Strain is an injury to muscles and tendon caused by excessive stretch or tension within the fiber (7). Tensile forces are produced when the muscle is stretched beyond its normal range of motion, causing the fibers to tear. Muscle fiber can also be damaged by dynamic over load, which occurs when the muscle generates more force than its fibers can withstand such as eccentric muscle contraction. Strain is grading of severity in three scales as followed (25).

First degree involves stretching and limited tearing of the fibers. Pain increases as the muscle contracts, especially against resistance and the site of injury is point tender. Swelling may be present as well.

Second degree strain involves the actual tearing of some of the muscle fibers and result in ecchymosis (a blue or purple area of skin caused by the movement of blood into the skin). These injuries present the same findings as a first-degree strain but are more severe.

Third degree strain involves the complete rupture of the muscle, resulting in a complete loss of function and a palpable defect in the muscle. Pain, swelling and ecchymosis are also present.

Table 2.4 Clinical findings of strain (25)

Examination segment	Clinical findings of muscle strain
History	**Onset**: Acute **Location of pain**: Pain is located at the site of injury, which tends to be at, or near, the musculotendinous junction, the most area often involve, proximal muscle belly or distal muscle belly. **Mechanism**: Strains usually from a single episode of overstretching of overloading of the muscle but is more likely to result from eccentric loading.
Inspection	Ecchymosis is evident in cases of severe strain. Gravity causes the blood pool to distal to the site of trauma. Swelling may be present over the involved area. In severe cases, a defect may be visible in the muscles or tendon. If the strain involves a muscle of the lower extremities, the athlete may walk with a limb.
Palpation	Point tenderness exists over the site of injury, with degree of pain increasing with the severe of the injury. A defect or spasm may be palpable at the injury site.
Functional tests	**AROM**: Pain is elicited at the injury site. In the case of 2^{nd} or 3^{nd} degree strain, athlete may be unable to complete the movement. **PROM**: Pain is elicited at the injury site during passive motion in the direction opposite that of the muscle, placing it on stretch. **RROM**: muscle strength is reduced. Pain increases as the amount of resistance is increased. Third degree strain results in a loss of function.

2.5.2 Tendinitis

Tendinitis is inflammation of the muscle tendon, which caused by single traumatic force of smaller repetitive forces or microtrauma on the site of injury as table 2.5 (25).

Table 2.5 Mechanisms leading to tendinitis

Mechanism	Implications
Microtrauma	Repetitive tensile loading, compression and abrasion of the working tendons. Insufficient rest periods allow for the accumulation of the microtrauma, possibly leading to tendon failure.
Macrotrauma	A single force is place on the muscle, causing direct tearing within the tendon or at the musculotendinous junction. This area becomes the weak link. When the forces of otherwise normal walking or running are sufficient to cause further inflammation.
Biomechanical alteration	The alteration of otherwise normal motion redistributes the forces around a joint, resulting in new tensile loads, compressive forces, or abrasion of the tendons. Examples of this include running on uneven train or using improper sporting equipment.

Table 2.6 Clinical findings of tendinitis (25)

Examination segment	Clinical findings of tendinitis
History	**Onset**: Gradual or chronic **Location of pain**: pain exists throughout the tendon. **Mechanism**: tendinitis results from microtraumatic forces applied to the tendon.
Inspection	Swelling may be noted. If inflammation involves a tendon of the lower extremity, the athlete may walk with a limb or demonstrate some other compensation gait. Inflammation involves the upper extremity results in abnormal movement patterns. Many tendons are not directly visible or palpable.
Palpation	The tendon is tender to the touch. Crepitus or thickening of the tendon may be noted.
Functional tests	**AROM**: Pain in the tendon is possible at the extremes of the ranges of motion as force is generated within the tendon. **PROM**: Pain is elicited during the extremes of the range of motion as tendon is stretched. Pain can be elicited earlier in ROM in more severe cases. **RROM**: Strength is decreased by pain. Pain is increased when the joint is isometrically stressed in its open-packed position.

Tendinits is grading by clinical findings as shown in table 2.6 (25). First degree is marked by pain and slight dysfunction during activity. Second degree results in decreased function and pain after activity. Third degree is characterized by contrast pain that prohibits activity.

2.5.3 Myositis ossificant and calcific tendinitis

These 2 injuries are prolonged chronic inflammation of muscle and tendon that result in the accumulation of mineral deposits resembling bone in the affected tissue (26). They do not involve muscles or tendon, but the connective tissue of fascia and its intramuscular extensions. The etiology of myositis ossificant can be traced to the genetic formation of abnormal tissue (myositis ossifications progressive), neurological disease, blood borne disease (myositis ossificans circumcripta) or trauma (myositis ossificans traumatic).

Table 2.7 Clinical findings of myositis ossifican (25)

Examination segment	Clinical findings of myositis ossificans
History	**Onset**: The initial is a heamatoma caused by a single acute or repeated blow to the muscle. The ossification occurs gradually. **Local of pain**: Pain occurs at the site of ossification, usually the site of large muscle mass that is exposed to blows. **Mechanism**: Single or multiple directs blows to a single area cause Myositis ossifican.
Inspection	A superficial bruise may be noted. Effusion of the distal joint closet to the site injury occurs. Ecchymosis may be present.
Palpation	Acutely, the muscle is tender. As the ossification develops, it may become palpable within the muscle mass.
Functional tests	**AROM**: This is limited by pain. As the ossification grows, the number of contractile units available to the muscle decreases. Antagonist motion is painful secondary to decreased flexibility. **PROM**: This is decreased secondary to pain and adhesions within the muscle. **RROM**: This is decreased secondary to pain. The ossification does not allow the muscle to contact normally.
Special tests	X-ray examination shows the ossification as it matures. A bone scan may be positive in the earlier stages.

Although, there are the clinical finding of myositis ossifican (25) as in table 2.7, the precisely diagnosis is special tests such as X-ray, CT scan or MRI.

Radiological evidence of intramuscular calcification generally is delayed in appearance for 6 to 8 months after onset with gradual evolution to mature bone over a period of subsequence (24).

2.5.4 Contusion

Contusion is resulted from an external force sufficient to cause muscle damage. Muscle contusion caused by compression sustains from heavier blows which damaged blood vessels (26). Muscle contusions may be has ecchymosis or tissue dislocation from superficial hemorrhage. Blood and lymph flow into the damage area swelling occurs, after resulting in the formation of hard mass composed of blood and dead tissue called a heamatoma. This mass may restrict joint motion. Nerve compression accompanies such as injuries, leading to pain and sometimes paralysis. Therefore, muscle contusion often associated with impaired joint range of motion that divided in 3 degree as followed (24-26).

First degree causes little to no range of motion restriction. Second degree causes a noticeable reduction in range of motion. And the fascia surrounding the muscle also is rupture causing swollen muscle tissue to protrude.

2.5.5 Muscle spasm and cramp

They make painful which reduce sport activities, although they are typically associates with injury. A cramp is a painful involuntary contraction, with contraction over a period of time (26). Cramps are bought on by a biomechemical imbalance, sometimes associated with muscle fatigue. Spasm is involuntary

contractions of short duration caused by relax action that can be biochemical derived or initiated by a mechanical blow to a nerve or muscle.

2.5.6 Delayed muscle soreness syndrome (DOMS)

This DOMS is exercise muscle injury. DOMS appears 12 to 48 hours after exercise induces muscle injury. DOMS appears 12 to 48 hours after exercise sessions and represents the clinical syndrome of exertion response of muscle injury (24). DOMS is characterized by tenderness of palpation, by increased muscle stiffness and by direction in range of motion (24). While the exact mechanism remains unsolved, there is considerable evidence for both inflammatory and metabolic dysfunction secondary to muscle damage (24). In inflammatory model, DOMS are response as

1. Pain, swelling and loss of function are observed
2. Cellular infiltrates are noted, particularly macrophages
3. Fibroblasts have seen in association with both events
4. Increased lysosomal activity occurs during both events
5. The progression and the size of the lesion occur in both instances in about 48 hours
6. Increased levels of Interluekin 1 and acute phase proteins occur in both events
7. Sign of healing are observed at approximately 72 hours

Structural abnormalities following eccentric exercise have been identified as (24)

1. Primary and secondary sacrolemmal disruption
2. Swelling or disruption of the sacrotubular system
3. Distortion of the myofibrils contractile elements
4. Cytoskeltal damage
5. Extracellular myofiber matrix abnormalities

2.5.7 Bursitis

Bursitis is inflammation of fluid-filled sacs that serve to buffer muscles, tendons and ligaments from other friction-causing structures and to facilities smooth motion (25). Normally, bursas can not be specifically palpated unless they are inflamed. The bursitis is caused by the irritation of the bursal sac secondary to a disease state, increased stress, friction or a single traumatic force that activities the inflammatory process.

The clinical findings that depend on the location of the involved structure (25) are as table 2.8.

Table 2.8 Clinical findings of bursitis

Examination segment	Clinical findings of bursitis
History	**Onset**: Acute in the case of direct trauma to the bursa, insidious in the case of overuse or infection. **Location of pain**: pain occurs at the site of the bursal sac. **Mechanism**: A direct blow to the bursa, causing to improper biomechanics. Infection: viral or bacterial invasion of the bursa.
Inspection	Local swelling of bursa can be very pronounced, especially those located over the olecanon process and patellar.
Palpation	Point tenderness is noted over the site of the bursa. Localized heat and swelling may be noted.
Functional tests	**AROM**: Pain may be noted. **PROM**: Pain is produced, if the motion causes the tendon or other structure to rub across the inflamed bursa. **RROM**: This is limited by pain. As the muscle contracts, it compresses the bursal sac.

2.5.8 Sprain

Sprain is injury, which occurs when a joint is stretched beyond its normal anatomical limits, resulting in the stretching or tearing of the ligaments and/or joint capsule (25). Sprains are considered in 3 degrees severity based on amount of laxity produced by injury relative to the opposite limb (table 2.9) (25).

Table 2.9 Grading system for ligamentous laxity

Grade	Ligamentous end-feel	Damage
I	Firm (normal)	Slight stretching of the ligament with little, if any, tearing of the fibers. Pain is present, but the degree of stability roughly compares with that of the opposite extremity.
II	Soft	Partial tearing of the fibers. The joint line "opens up" significantly when compared with the opposite side.
III	Empty	Complete tearing of the ligament. The motion is restricted by other joint structures.

First-degree sprain: The ligament is stretched with little or no tearing of its fibers. When joint is stressed, not abnormal motion is produced. And it has firm end-feel. There is local pain, mild point tenderness and slight swelling of the joint.

Secondary-degree sprain: There is partial tearing of the ligament's fibers, resulting in joint laxity when the ligament is stressed, but definite end-feel is present. It also produce moderate pain and swelling, which occurs and loss of the joint's function.

Third-degree sprain: The ligament is completely ruptured, causing grosses joints instability and an empty or absents end-feel. Swelling is presented, but pain may be limited secondary to tear of local nerves. A complete loss of joint functional is noted.

The clinical findings of sprain are as in table 2.10 (25).

Table 2.10 The clinical findings of sprain

Examination segment	Clinical findings of sprain
History	**Onset**: Acute **Location of pain**: Pain is localized to the site of injury with first-degree sprain. As the severity of the sprain increases, the pain is radiated throughout the joint. The athlete may report a "popping" sensation or sound. **Mechanism**: Sprain is resulted from tensile forces caused by the stretching of the ligament.
Inspection	Swelling of the joint is evident. Ecchymosis will form at, and distal to, the site of injury.
Palpation	Point of tenderness is noted over the ligament. The entire joint may be tender.
Functional tests	**AROM**: this is limited by pain in the direction that stresses the involved ligament(s). **PROM**: This is limited by pain, expeciaaly in the direction that stresses the involved ligament(s). **PROM**: manual resistance throughout the range of motion is painful. Isometric concentrations may not produce as intense pain.
Ligamentous test	The ligament can be stressed by producing a force through the joint that causes the ligament to stretch. The examiner should note the amount of increased laxity as compared with the opposite side, as well as the quality of the end-point. The end-point should be district and scrip. A soft, "mushy" or absent end-point is a sign of ligamentous rupture.
Special test	The particular joint being examined determines these.

2.5.9 Subluxation

This injury involves the partial or complete disassociation of the joint's articulating surface (25). This injury may or may not spontaneously return to there such as tearing of capsule or ligament, because the amount of force to displace bony is aggressive. Subluxation is a progressive condition by stretching the supporting structures. In clinically, joint subluxation is established by history of the "joint went out and then popped back in". Pain and instability that noted during ligamentous and capsule tearing would limit joint displays. Clinical findings of joint subluxation are shown in table 2.11 (25).

Table 2.11 Clinical findings of joint subluxation

Examination segment	Clinical findings of joint subluxations
History	**Onset**: Acute, chronic subluxation, which can occur as the joint's supportive structures are progressively stretched. **Location of pain**: pain occurs throughout the involved joint. Associated muscle spasm may involve the muscles proximal ansdistal to the joint. **Mechanism**: Joint subluxation results from a stress that takes the joint beyond its normal anatomical limits.
Inspection	Swelling isusually present. No gross deformity is noted because the joint relocates.
Palpation	Pain along the tissues that have been stretched or composed.
Function tests	**AROM**: This is limited owing to pain and possible instability. **PROM**: This is limited owing to pain and possible instability. **RROM**: Muscle strength is decreased secondary to pain and joint instability.
Ligamentous tests	Pain is elicited during stress testing of the involved ligaments. Laxity of the tissue is present, particularly postacutely. The athlete may note instability and react to guard against this by contracting the surrounding musculature or pulling away, an apprehension response.
Special test	These vary according to the body part being tested.

2.5.10 Joint dislocation

This injury is complete disassociation of the joint's articulating surface (25). This injury associated with many soft tissues ruptured from aggressive forces. If major joint such as knee, ankle is dislocated, the distal pulse and the normal sensory distribution of the involved extremity must be established. This injury is also considered medical emergency case. The clinical finding of joint dislocation is shown in table 2.12.

Table 2.12 The clinical findings of joint dislocation (25)

Examination segment	Clinical findings of joint dislocation
History	**Onset**: Acute, chronic, which dislocation occurs as the joint's supportive structure are progressively stretched **Location of pain**: At the involved joint. **Mechanism**: Dislocation is caused by a stress that takes the joint beyond its normal anatomical limits.
Inspection	Gross joint deformity may by present and swelling is observed.
Palpation	Pain is elicited throughout the joint.
Functional test	Rage of motion is not possible because of the disruption of the joint's alignment.
Ligamentous test	These are contraindicated at this time.
Neurological test	Sensory distribution distal to the dislocation joint should be established.
Special test	Except for checking neurovascular injury, these are contraindicated at this time.
Comments	Dislocations of the major joint represent a medical emergency. The presence of the distal pulse must be established. A lack of circulation to the distal extremity the viability of the part.

2.5.11 Synovitis

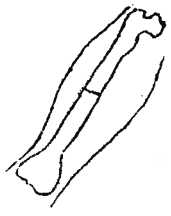
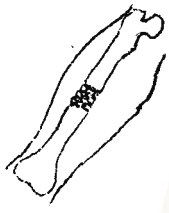
Synovitis is inflammation of joint capsule, which often occurs secondary to the presence of existing inflammation in or around the joint that spreads to the synovial membrane (25). Athletes often complain "bogginess" within the joint and to hold it in a position that applies the least amount of stress on the capsule's fiber. The clinical finding of this injury is demonstrated as table 2.13.

Table 2.13 Clinical findings of synovitis (25)

Examination segment	Clinical findings of synovitis
History	**Onset**: insidious; often subsequent to a previous injury to the joint. **Location of pain**: Pain occurs throughout the entire joint. Causing aching at rest and with activity. **Mechanism**: The synovial lining becomes inflamed, often following an injury to the joint. The resulting inflammation reaction within the synovium.
Inspection	The joint may appear swollen. The athlete may move the joint in a guarded manner.
Palpation	Warmth may be felt. A boggy swelling is present. No district area of point tenderness is usually present.
Functional tests	**AROM**: Limitations exits within the capsular of the joint. **PROM**: Normally, this is greater than active range of motion but is still limited by pain. **RROM**: Weakness is present owing to muscular contraction.
Ligamentous tests	In the absence of underlying pathology to the ligaments, the ligamentous tests result is negative. Pain may be elicited by stretching the inflamed tissues.
Special tests	Same findings are produced as for ligamentous testing.
Comments	The sign and symptom of synovitis may mimic those of an infected joint. A history of overuse of closed trauma to the involved joint is needed to identify synovitis.

2.5.12 Fracture

Fracture is disruption in the continuity of a bone. Type of fracture depended on the type of mechanical loading that caused it as figure 2.1 (25). The severity of fracture depended on the fracture line as incomplete fractures, placed fractures, displaced fractures and open fractures (25).

	**Depressed fractures** occur from direct trauma to flat bones, causing the bone to fracture and depress.
	**Transverse fractures** are caused by a direct blow, ***shear force***, or tensile force being applied to the shaft of a long bone and result in a fracture line that is perpendicular to the bone's long axis.
	Extremely high-velocity impact forces can result in the shattering of bone into multiple pieces, a **comminuted fracture**. This type of fracture often requires surgical correction.
	***Compressive forces*** placed through the long axis of the bone can lead to a **compacted fracture**, in which one end of a fractured segment is driven into the opposite piece of the fracture, often leading to a shortening of the involved limb.
	A rotational force placed on the shaft of a long bone, such as twisting the tibia while the foot remains fixated, can result in a **spiral fracture**, in which the fracture line assumes an S-shape along the length of the bone.
	**Longitudinal fractures**, most commonly occurring as the result of a fall, have a fracture line that runs parallel to the bone's long axis.
	Generally specific to the pediatric and adolescent population, **greenstick fractures** involve a displaced fracture on one side of the bone and a compacted fracture on the opposite side. The name is derived from an analogy to an immature tree branch that has been snapped.

	Fracture lines not completely discommunicating the proximal end of the bone from its distal end are described as **incomplete fractures**.
	Fracture lines with complete disassociation between the two ends of the bone are termed **undisplaced fractures** if the two ends of the bone maintain their relative alignment to each other.
	**Displaced fractures** involve the loss of alignment between the two segments and may jeopardize the surrounding tissues.
	An **open fracture** (compound fracture) occurs when a displaced fracture exits the skin.

Figure 2.1 Types of fracture (25).

When athletes have fracture, they report as audible snap or crack at the time of injury including pain along the fracture site and may radiate up the extremity. Palpation may reveal crepitus or discontinuity along bone fracture result immediate dysfunction and an inability to bear weight. However, athletes suffering fibular fracture, may still be capable of walking.

2.5.13 Stress fracture

Stress fracture or fatigue fracture results from repeated low magnitude forces that worsen over time (25). It is beginning as small disruption in the community of the outer layers of cortical bone and ending as complete cortical fracture with possible displacement of bone ends. The clinical findings of stress fracture are in table 2.14 (25).

Table 2.14 The clinical finding of stress fracture

Examination segment	Clinical findings of stress fracture
History	**Onset**: Insidious. The athlete cannot report a single traumatic event causing the pain **Location of pain**: Pain tends to radiate from the involved bone but may become diffuse. **Mechanism**: Cumulative microtrauma causes stress fractures.
Inspection	Usually on bony abnormality is noted. Soft tissue swelling and redness may be present.
Palpation	Point tenderness exits over the fracture site.
Functional tests	**AROM**: This is usually within normal limits. **PROM**: This is usually within normal limits. **RROM**: This is usually within normal limits.
Special tests	Long bone compression test. Percussion along the length of the bone. Bone scans or other imaging techniques.

2.5.14 Abrasions

Abrasions are caused by shear force when the skin is scraped with sufficient force in one direction, against a rough surface (26). The more layers of skin are scraped away, if it is greater applied force.

2.5.15 Blister

Blister is caused by repeated application of shear in one or more direction (26). The consequence is a pocket of fluid between the epidermis and dermis as fluid migrates to the site of injury.

2.5.16 Skin bruise

This injury is caused by compression sustained during a blow (26). The underlying capillaries are damaged that cause the accumulation of blood within the skin.

2.5.17 Incision

This incision is a clean cut that produced by the application of tensile force to skin as it is stretched tear along a shape edge (26).

2.5.18 Laceration

This skin injury is an irregular tear in the skin that typically resulted from a combination of tension and shear (26).

2.5.19 Avulsion

This injury is also skin injury that is severe than laceration. This injury is complete separation of skin from the underlying tissue (26).

2.5.20 Puncture

This injury has wound which resulted by application of a sharp, cylindrical object, penetrates the skin and underlying tissue with tensile loading (26).

2.6 Sport Injury and Prevention

Mechelen et al in 1992 (7) also suggested the best way to prevent sport injury like the 'Sequence of prevention' which has 4 steps as establishing the extent of the sport problems, establishing etiology and mechanism of injuries, introducing preventive measures and assessing their effectiveness by repeating method in first step.

There are three conceptual injury models that are usually described the etiology of injury as stress-capacity balance model, sport behavior model and stress-strain-capacity model.

The stress-capacity balance model is a balance between internal and external risk factors (see table 2.15). Stress can be determined by external factors (the athlete's environment). Capacity of athletes can be determined by the state of internal factors. The injury will happen when the balance has changed. If the one of two factors is reduced or raised as balance again, the preventive measure will succeed.

Table 2.15 The internal and external factors which may occur during injuries

Internal Factors	External Factors
Physical defect	**Sports-ralted factors**
Physical fitness	Type of sport
Aerobic endurance	Exposure
Strength	Nature of opponents and team mates
Sporting skill/coordination	**Venue**
Flexibility of muscles	State of floor or ground
Previous injuries	Lighting
Psychological factors	Safety measures
Self-concept	**Equipment**
Risk acceptance	Tools
Personality	Risk acceptance
Locus of control	Other equipment (shoes, clothing etc.)
Physical build	**Weather conditions**
Height	Temperature
Weight	Relative humidity
Joint stability	Wind
Body fat	**Training**
Age	Conduct of match rules
Sex	Referee's application rules

However, there is no relationships between risk factors and injury. Sometime athletes have risk factors although they did not have injured. There may be that both risk factors and injury are dependent on other related factors in different way. In the other words, the stress-capacity balance model can not describe all etiologies of injuries. Therefore, mechanism of injury is used to identify mechanics, which produce injury occurrence. The mechanism of injury determines stress during sport activities eventually leading to tissue damage (9). The mechanism is often represented in terms of direction and characteristics of the applied forces and involved structure.

Therefore, the mechanism can be divided into 2 categories, i.e. traumatic disruption and overuse syndromes (24,25,30). Traumatic disruptions are resulted from direct loading to the area. The tissues are damaged when rapidly applied loads produce

strain beyond which tissues can tolerate. Forces from contacts and non-contacts can produce this injury. Contact may occur between participants or participants and an object. Non-contact injury is self-induced and often arises from the athlete producing force of movements that the body tissues can not withstand. This traumatic injury is usually caused by single event that athlete can describe in detail how the injury occurred. Overuse syndromes are injuries resulted from chronic cyclic activities, which produce low repetitive and high-magnitude load or high repetitive and low magnitude load. The injured athlete can not describe detail of the occurrence of this repetitive injury but can establish the activities or movement causes the pain.

Generally, movement which produce injury is usually determined the mechanism. Moreover, mechanism of injury may be identified in each category by the questions. How did the injury occur? Athlete's descriptions of injuries will describe the mechanisms (e.g. I rolled my ankle in). Was the injury caused by single force or by repetitive force? However, the movement during injury is not enough to consider mechanism of injury. The conditions, which include internal and external factors during injury, are identified, because these conditions could produce psychological effect and stress to athletes. Some additional questions are introduced to identify conditions that may be mechanism of injury (15). When did the injury happen, during training or warm-up? Did the injury occur during tournament or recreational? Did the injury occur because the rules of the game were violated? Did the equipment or lack of the some have any connection with the injury? Did any carrier injuries influence the current accident?

There are interaction between personal characteristics (physical, psychological) and sport environment (3,7). Sport behavior model is used to describe all factors (internal and external) and conditions that produce sport injuries (see figure 2.2). Sport environment, personal equipment, loads and internal factors in athletes would produce sport behavior, which involved in the injury's activities. Attitude, social influence and self-efficacy are usually used to determine the sport behavior (32).

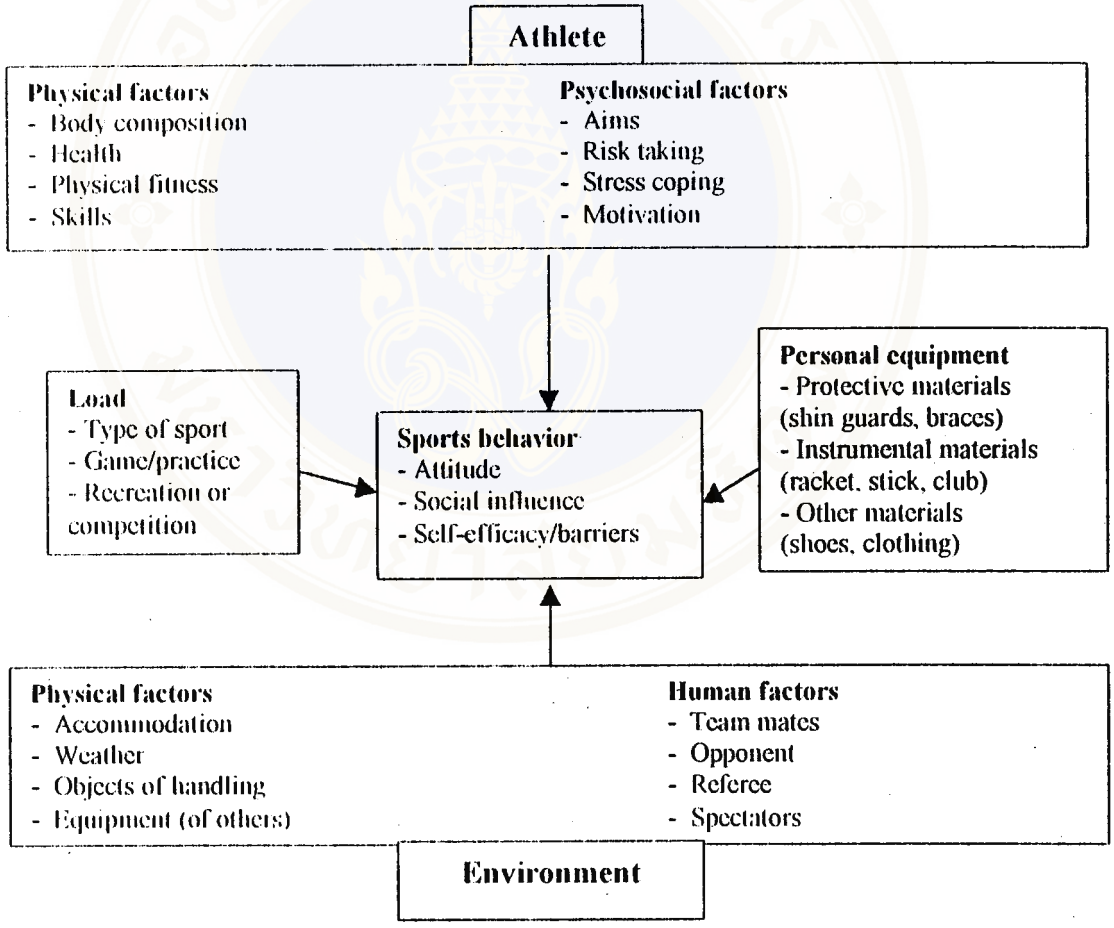


Figure 2.2 Determinants of sports behavior.

However, the sport behavior model can not describe the etiology of overuse syndrome. Because the overuse syndrome is an insidious injury, it used to have a period of time to produce symptom. In other words, the stress-capacity model and sport behavior model can not describe about time perspective of injury. Therefore, the stress-strain-capacity is introduced as figure 2.3 (7).

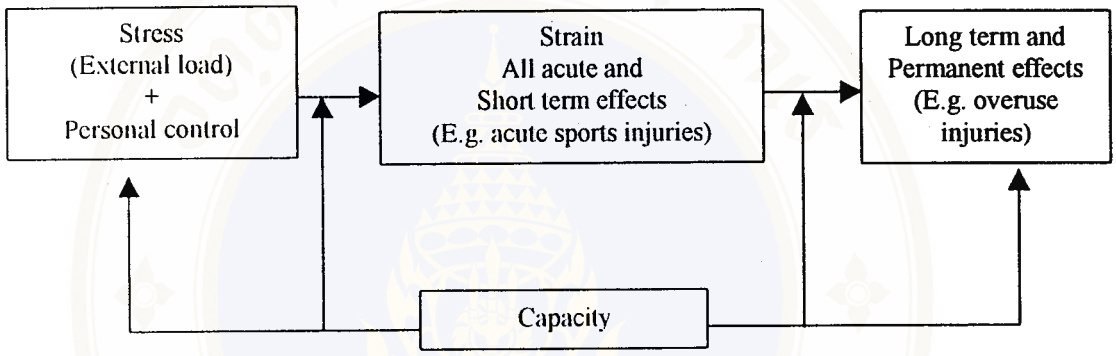


Figure 2.3 Stress/strain/capacity model.

The stress-strain-capacity model is a time-based 3 phases sequential model. Stress is external load, i.e. all external factors affecting sport activities. Strain is all processes, which respond in body or the result of stress and personal control. Personal control is the ability of athlete to actively influence the amount of imposed stress. Strain produces short-term effect and long term effect. Sweating, fatigue, diminished reaction speed, blood lactate accumulation through acute sport injuries are indicators of short term after effect of strain. Long term and permanent after-effect are all nonacute after-effect that still present at the onset of the next occasion of stress (sport activities). Long term refers to the reversible effects and permanent to irreversible effect. These effects may be in positive or negative effects such as improved

performance, improved self-efficiency, muscle soreness, mood disturbance and lower self-extreme. Capacity is the sum of all internal factors that allows athletes to perform in sport. Physical factors, skills and psychological/behavioral factors such as knowledge, motivation, attitude, age and sex represent the internal factors of this capacity. Unfortunately, there are no dominant instruments to measure the effect of psychological and behavioral factors, although these factors are of indicators of capacity.

The stress-strain-capacity model presents as the active manipulator of stress. Athlete throughout sport activities as capacity can alter the strain, although the activities are influenced by strain. The strain has gone beyond the limits of individual capacity, then, the injury will occur. The limits are represented as 1) reduction of the amount or level of sport activities; and/or 2) need (medical) advice or treatment; and/or 3) adverse of social or economic effect (7,33). Overuse injuries are result of repetitive movement, predominantly restricted to muscle, tendon or joint, whereas the acute injuries are acute tissue damage, as a result of a single trauma. Incomplete tissue recovery is important role in the origin of overuse syndrome.

Stress-strain-capacity model is the result of a complex interaction of various factors. The specific preventive measures should ask specific factors (physical, psychological, behavioral) to determine what specific injury in what specific sport activity and during when specific time. Therefore, the research on sport incidence and research on risk factors should be conducted in a homogenous group; age, sex, level of competition and type of sport.

2.7 Sepaktakraw

Sepaktakraw is a popular sport in South East Asia especially in Thailand (34). Sepaktakraw is non-contact and an excellent sport where players flip to kick a rattan ball over a net at high speed. An unholy combination of gymnastics, soccer and volleyball are related into one. Sepaktakraw is played over a net as volleyball, except those players can not touch the ball with hands or arm as football. Some activities are a flurry action, cart-wheeling bodies slicing through the air and whipping and odd looking at each other. Speed, grace, skill and whip-like reaction times are the key ingredients of this sport. Competitions of Sepaktakraw classify into 2 events; Regu and Team. Team event consists of 3 Regues (12 players). Each Regu (single team) has 4 players, but only three are on the court at one time that is one player of Back or server, one Right Inside and one Left Inside. One of Insides is Feeder position and another one is Attacker position. In each event consists of 2 teams (Regues) where are in different courts. Each team is allowed three contacts the ball to get it over the net, as volleyball. Dissimilar concept of volleyball, one of Sepaktakraw players may take more than one contact consecutively. The length of game varies with no time limit. The win of a match has to win 2 out of 3 sets. Each set must reach 15 points, except the third set is played to only 6 points as tiebreak. To start the game, one of Insides throws or tosses ball to the server or Back. One foot of the server is inside the center circle and another one outside. The ball is kicked over the net by the outside foot. Moreover, after received the serving ball, feeding and attacking is played. Attacking, especially Roll Spike, is aggressive action. Roll spike is rapidly backward somersault in the air with height jumping.

In international level of Sepaktakraw, Thai national team is the lead over others national teams. This is because the origin of this sport was in Thailand, although Malaysia also pronounces claim that Sepaktakraw was originating their land. The two national teams, Thai and Malaysian, are different in specific tactics. One of Thai tactics is the roll spike, a twisting back flip where the athlete kicks a leg over the opposite shoulder and whipping the ball into the opponent's court. Moreover the Thai teams have aggressive serving. In the other word, Thai team is strength in attacking, whereas the Malaysians teams are stronger on defense.

2.7.1 Rules of Sepaktakraw

These following amendments have been approved at The International Sepaktakraw Congress at Bangkok, Thailand on 23 November 1996.

1. The court (figure 2.4)

1.1 Area of 13.4 meters x 6.1 meters free from all obstacles up to the height of 8 meters measured from the floor surface (sand and grass court not advisable).

1.2 The width of the lines bounding the court should not be more than 0.04 meters measured and drawn inwards from the edge of the court measurements. All the lines should be drawn at least 3.0 meters away from all obstacles.

1.3 The Center Line: The Center Line of 0.02 meters should be drawn equally dividing the right and left court.

1.4 The Quarter Circle: At the corner of each at the Center Line, the Quarter Circle shall be drawn from the side line to the Center Line with a

radius of 0.9 meters measured and drawn outwards from the edge of the 0.9 meters radius.

1.5 The Service Circle: The Service Circle of 0.3 meters radius shall be drawn on the left and the right court. The center of this circle is 2.45 meters from the back line of the court and 3.05 meters from the sidelines. The 0.04 meters line shall be measured and drawn outward from the edge of the 0.3 meters radius.

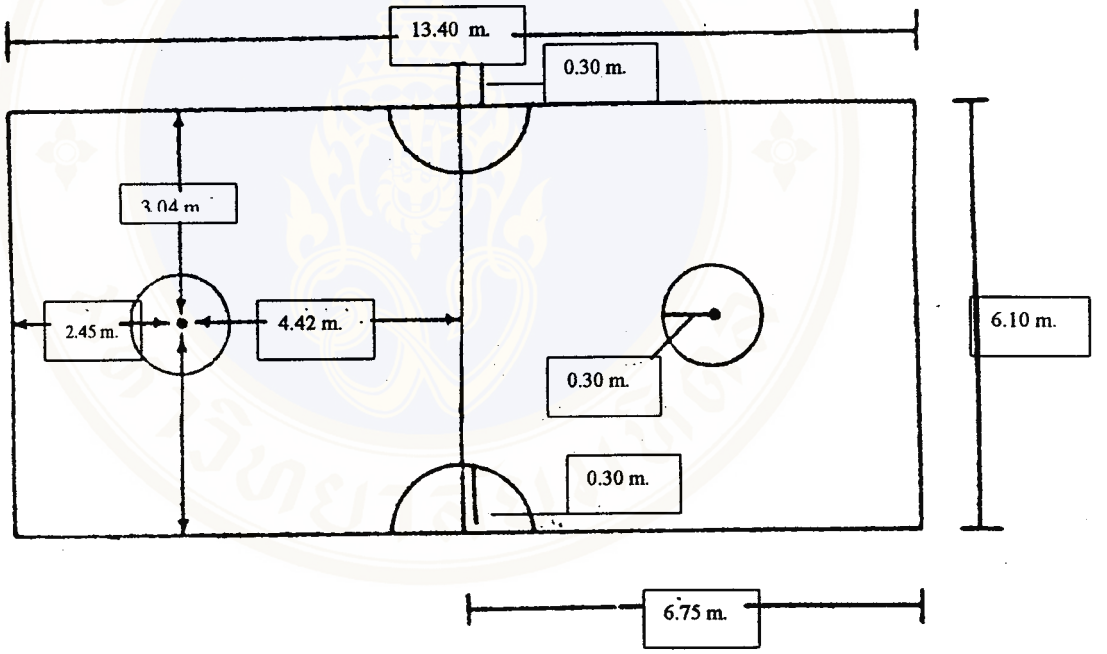


Figure 2.4 The court of Sepaktakraw (35).

2. The posts

2.1 The posts shall be 1.55 meters in height from the floor and shall be sufficiently firm to maintain high net tension. It should be made from very strong materials and shall not be more than 0.04 meters radius.

2.2 Position of posts. The posts shall be erected or placed firmly 0.3 meters away from the sideline and in line with the Center Line.

3. The net (figure 2.5)

3.1 The net shall be made of fine ordinary cord or nylon with 0.06 meters to 0.08 meters mesh. The net shall be 0.7 meters in width and not shorter than 6.10 meters in length and taped at both ends with 0.05 meters tape from top to bottom to be in line with the court sidelines, called boundary tapes.

3.2 The net shall be with 0.05 meters tape double at the top and bottom of the net supported by a fine ordinary cord or nylon cord that runs through the tape and strain over and flush with the top of the posts. The top of the net shall be 1.52 meters in height from the center and 1.55 meters at the posts.

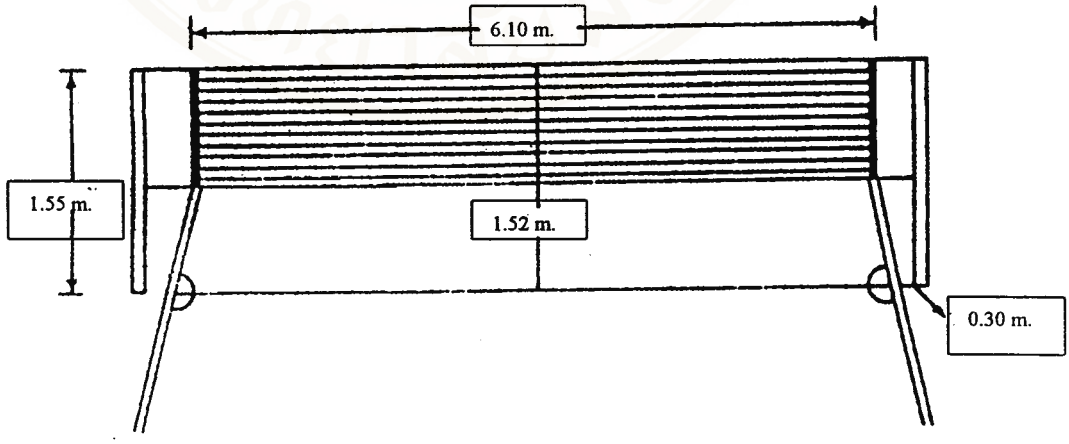


Figure 2.5 The net of Sepaktakraw (35).

4. The Sepaktakraw Ball (figure 2.6)

The sepaktakraw ball shall be spherical of one wove layer having 12 holes, 20 intersections. It shall be made of synthetic fiber or natural rattan, If it made of rattan, it shall consist of 9-11 strains. The circumference shall not be less than 0.42 meters and not more than 0.44 meters. The weight before play shall not be less than 170 gram and not more than 180 gram.

A. Rattan ball B. Synthetic ball

Figure 2.6 Takraw ball (35).

5. The players

5.1 The game is played between 2 "Regu"s that consist of three players on each side.

5.2 One of the three players shall be at the back, and he is called "Back".

5.3 The other two players shall be in front, one on the left and the other on the right. The player of the left is called "Left Inside" and the player on the right is called "Right Inside".

6. Player's attire

6.1 The male players must wear jerseys or T-shirts, and sport shorts and sports shoes with rubber soles. It is forbidden for players to wear anything that endangers the opponents during the game. In case of cold weather, the players are permitted to use tracksuits.

6.2 The entire apparel of a player is regarded as part of his body. All jerseys or T-shirts should be tucked in.

6.3 Anything that helps to speed the ball or that helps the movement of the player is not allowed.

6.4 The Captain of each 'Regu" shall wear an armband on the left arm.

6.5 All jerseys or T-shirts are to be numbered at the back. A player must be assigned with one permanent number throughout the tournament. Only number 1-15 are allowed to be used by each participating team. The size of the number shall be not being less than 19 centimeters in height.

7. Substitution

7.1 Substitution is allowed at any time on request made by the team manager to the Official referee when the ball is not in play.

7.2 Each 'Regu" is allowed to make one substitution only.

7.3 A player, who is sent off by the umpire during the game, may be allowed to be substituted, provide the substitution has not already been made.

7.4 Any player having played for any 'Regu", whether in the starting lineup or as a substitute, will not be allowed to play on another Regu for the team in the current game.

7.5 Any 'Regu" having less than 3 players will not be allowed to continue the game and will be considered as having lost.

8. Officials

The following officials shall manage the game:

1 Official referee

2 umpires

6 linesmen (4 sideline and 2 base line)

9. The toss and warm up

Before commencing the game, the umpire will toss a coin or disc and the side winning the toss shall the option of "First Serving" or of "Choosing Side". The "First Serving" shall "warm-up" first for 2 minutes followed by the other "Regu". Only 5 persons are allowed to move freely in the court with the official ball.

10. Position of players during service

10.1 At the start of play, the players of both "Regu"s must be in their respective courts in a position.

10.2 The serving "back" player shall have one of his feet inside the serving circle. The another foot must be set outside the circle to kick the service ball.

10.3 Both of the "Inside" players on the service side must be in their respective quarter circles.

10.4 The opponent or receiving regu is free to be anywhere within its court.

11. Start of play and services

11.1 The side that chooses "First Serving" shall start the first set. The winner of the first set shall change courtsides and start the second set.

11.2 The throw must be expected as soon as the umpire calls the score. If either of the "Inside" player throws the ball before the umpire calls the score, it must be re-thrown and a warning will be given to the thrower.

11.3 During the service, as soon as the server kicks the ball, all the players are allowed to move about freely in their respective courts.

11.4 The service is valid if the ball passes over the net, whether it touches the net or not, and inside the boundary of the two net tapes and boundary lines the opponent's court.

11.5 The execution of the serve by the "Back" player can be kicked in any manner, provided one of his feet must always touching the ground in the service circle.

12 Faults

12.1 The serving side during service.

12.1.1 The "Inside" player who is making service throws, plays about with the ball such as throwing up the ball, bumping, giving to other "Inside" player, after the call of score has been made by the umpire.

12.1.2 The "Inside" player lifts his feet or steps on the line or crosses over or touches the net while throwing the ball.

12.1.3 The "Back" player, while kicking the service ball, the other foot does not touch the ground or steps on the service circle line.

12.1.4 The "back" player does not kick the ball on the service throw.

12.1.5 The ball touches his own player before crossing over the opponent's court.

12.1.6 The ball goes over the net but falls outside the court.

12.1.7 The ball does not cross to the opponent's side.

12.2 Receiving side during the service

To create distracting manner or noise or shouts at his opponent are not allowed.

12.3 For both sides during the game

12.3.1 Stepping on the Center Line.

12.3.2 Any player touches the ball on the opponent's side.

12.3.3 Any part of player's body crosses over into the opponent's court whether above or under the net except during the follow-through of the ball.

12.3.4 Playing the ball more than 3 times in succession.

12.3.5 The ball touches the arm.

12.3.6 The ball rolls over the body.

12.3.7 Stopping or holding the ball under the arm, between the legs or body.

12.3.8 Any part of the body or player's outfits e.g. shoes, jersey, head band, etc., touches the net or the post or the umpires chair or falls into the opponent's side.

12.3.9 The ball touches the ceiling, roof or the wall (any objects).

12.3.10 Any player delays the game unnecessarily.

13. Change of service ("Service over")

Change of service is given when the serving side makes any fault or the receiving side kills the return.

14. Time out

Each "Regu" can request for one "time out" lasting of one minute's rest by team manager or official coach per set when the ball is not in play. Only five persons are allowed at the base line.

15. Scoring of points

A point is given to the serving "Regu" when opponent has made any fault according to Rule 12.

16. Scoring system

16.1 The winning point for a set is a maximum of 15 points.

16.2 To allow for 2 minutes rest at the end of the first and second set respectively.

16.3 If each "Regu" wins one set, the game shall be decided in the third set called "Tie Break".

16.4 Before the tiebreak set takes place, the umpire shall toss a disc or coin, and the side winning the toss shall have the option of choosing side or of serving first.

16.5 The changes of side will occur when one "Regu" reaches 3 points.

17. Temporary suspension of play

17.1 The umpire can suspend play temporarily in the event of obstructions, disturbances or any injury to a player who needs immediate treatment, for not more than 5 minutes.

17.2 An injured player is allowed up to 5 minutes injury time out. If after 5 minutes, the player is unable to continue, a substitution must be made. If the injured player's team has already made a substitution, the match will be declared a forfeit in favor of the opposing team.

17.3 In the course of such suspension, all players are not allowed to leave the court to receive drinks or any form of assistance.

18. Discipline

18.1 Every player must abide by the Rules of the game.

18.2 Only the captain of the "Regu" is allowed to approach the umpire during the game.

19. Penalty

The following offense will be penalized:

19.1 Showing dissent by words or actions towards any officials with regards to any decision and to any players or spectators.

19.2 Using foul or abusive language to any officials, players or spectators.

19.3 To take any improper steps or actions in order to influence any decision made by the officials.

19.4 To leave the court without the permission of the umpire (except between the second and third set).

19.5 Giving the ball to his opponent by kicking the ball with the feet.

19.6 Committing ungentlemanly conduct.

19.7 Disobeying orders and rules of play.

The umpire will penalize players disobeying Rules 19. The umpire will use following cards.

Yellow card. ⟶ Caution. Red card. ⟶ Expulsion.

Note:

Any player who is shown the Red card will be sent off the court and disciplinary action will be taken against him. The player concerned will not be allowed to play in any game until sanction has been made.

20. Misconduct of team officials

Disciplinary action will be taken against team officials or his team for any misconduct or disturbances committed by official or team during a tournament whether in or outside the court.

21. General

In the event of any question or any matter arising out of any point which is not expressly provided for the rules of the game, the decision of the official referee shall be final.

2.7.2 Playing and tactics of Sepaktakraw

There are basic plays in Sepaktakraw (35).

1. Playing with medial side of foot

This play is kicking the ball by medial side of one foot. It is used any time in a game such as receiving service ball or feeding.

2. Playing with dorsum of foot

This play is kicking the ball by dorsum of foot. It is used to play when the ball is far and difficulty to play by medial side of foot. It is often used to receive the aggressive balls, block or other balls, which are very close to the net.

3. Playing with knee

Anterior thigh slightly above the knee joint is used to play for receiving aggressive and a spin ball. It is safe play and often used to make the balls fly high. Play with the thigh is also used to receive the fast ball that is difficult to receive by other basic plays.

4. Playing with head

Playing with the head is assured to keep serving or attacking ball, which is aggressive and spins ball. The forehead is used to play the ball while the head is nodding. Head movement also used to control the directions of the ball.

There are 8 plays and tactics of Sepaktakraw (36)

1. Throwing or toss

The game starts when the ball is tossed by left or right Inside to the server. A good throwing will help make a successful service that is a rhythmical toss with the serving leg.

2. Serving or service (figure 2.7)

A serving continues from a toss. Serving is a process of hitting the ball to opponent field by medial or dorsum of foot while another foot is still in the

Central Circle The server should fashion swing the whole lower extremity in rapid and circular to kick the ball. The ball is very aggressive when the server uses his dorsum of foot to serving. The successful of service is when the ball falls in opponent field at the sharp angle or the ball is out after touching opponent's body.

Figure 2.7 Serving of Sepaktakraw.

3. Receiving service the ball

Receiving ball after service by an opponent is the first ball of all 3 balls to play. The ball could be played by dorsum of foot, head, knee, medial side of foot, shoulder or other body parts. The good receiving the ball is easy to follow by setting or attacking. Any of the 3 players could play this receiving.

4. Setting the ball or feeding

The setter or feeder, who is one of the *Insides*, will often set the ball, which continues from receiving service ball and followed by attacking. The

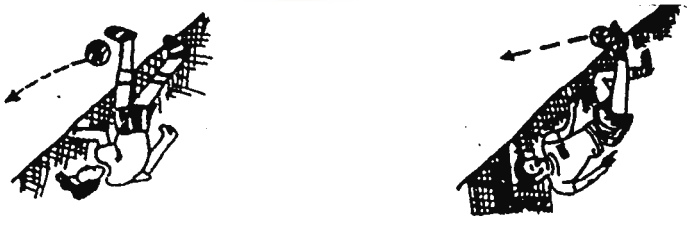
attacker or server could also do the setting. Medial side of the foot or head is usually used for setting the ball. The successful setting is the ball that is easy to attack.

5. Attacking the ball

A good attacking ball is when the ball falls in the opponent field and it is hard to receive. The attacker or killer usually plays the attacking, but other players can also play. Generally, movement and flexibility of trunk, back and lower extremities are needed to control the directions and the force of the ball. There are 5 ways of attacking.

5.1 Somersault attacking or Roll Spiking (figure 2.8)

This attacking is a backward somersault in the air and the ball is kicked over the opposite shoulder. This action produces an aggressive ball. Thai national athletes often use it. The somersault can be played with full or half circle. The half circle produces a short ball but less aggressive than the full circle one.



A. Full circle. B. Half circle.

Figure 2.8 Summersaults attacking or Roll Spike (36).

5.2 Alternating feet or Sun-back Spiking (figure 2.9)

This attacking is to alternate feet while back standing to net. The attacker jumping and alternating the feet to kick the ball in the air. (Malaysians often use it) The first leg in the air is non-dominant followed by the dominant foot which often used to hit the ball.

Figure 2.9 Alternating feet or Sun-back Spiking (36).

5.3 Treading the ball (figure 2.10)

This attacking produces fast ball and short distance ball. Players could stand or run and take-off to jump, then vertically separate their legs to tread the ball.

A. While standing.

B. While jumping.

Figure 2.10 Treading the ball (36).

5.4 Slapping the ball (figure 2.11)

This slapping could also make a fast and short distance ball. After jumping or standing, players rise their dominants foot over the net and use the medial side of foot to slap the ball. Movement of lower extremity is used to control the directions of the ball.

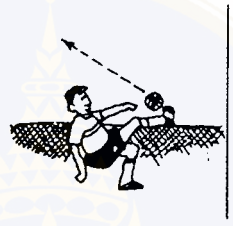


Figure 2.11 Slapping the ball (36).

5.5 Heading the ball

Head movement plays this attack with or without jumping.

6. Blocking (figure 2.12)

Blocking is action to against the attacking ball. Head, back or side of the body through lower extremity can be used to block the ball. Jumping at 10-15 centimeters over 1.55 meters (net height) is used when blocking. Normally, to take-off for blocking, the blockers have to jump for a very short time after the attacker. The players can raise their hand and arm to protect their heads and faces. However, the ball contacted arm and hand will considered as a fault ball.

A. With hand protect head and face B. Without hand protect head and face

Figure 2.12 Blocking (36).

7. Receiving the blocked ball

This receiving, after blocking by opponent, is played by body areas except hand and arm as the receiving service ball.

8. Defense

Defense is a tactic to play the ball without blocking. Defenders have to plan for guarding their court by basic plays. The successful defense is to score in serving team and to have a chance of serving in defense team.

CHAPTER III

MATERIALS AND METHODS

3.1 Subjects

Twelve Thai male national Sepaktakraw athletes who participate in practice and game sessions during an international tournament were recruited in this study.

3.2 Study Design

This study was a prospective study. The period of time for the study included pre and during an 13th Asian Games tournament which also included training and competition session between 29th September 1998 to 17th December 1998.

3.3 Materials

3.3.1 Questionnaire: status of previous injury.

3.3.2 Collecting forms:

1. Personal information
2. General status of session
3. Details of injury and information of physical examination

3.4 Criteria of Injuries

Sport injuries were collected during training programs and competitions of Thai male national Sepaktakraw team. The criteria of injuries defined as followed (8,14,20,33).

1. The injuries that athletes requested medical or physical therapy attention.

2. The injuries that had obviously tissue damages.

The injuries could make the athletes miss at least a part of training program or game sessions.

3.5 Procedure

On the first day of study period, all subjects registered personal information. Present injuries with its status including area, mechanisms, severity and previous treatment were collected by the questionnaire. This forms were filled by each subject (see figure 3.1 and appendix A).

Personal information, which recorded on the first day, was following (see appendix C)

1. Subject characteristics (age, high-weight, experience in Sepaktakraw, position in team, past medical history, dominant site, other diseases, flexibility, passive range of motion of extremities, alignment of lower extremities in standing and other visible deformity).

2. Guarding devices and supports or personal equipment (headband, thigh stocking, ankle support, knee support, elastic bandage, sport-tape) used during play Sepaktakraw (see appendix B).

Characteristics of training and competition were recorded during the study period. That were program training (aerobic, weight training or skill training of Sepaktakraw), length of session period, type of session (practice or game), team ranking in the competition session, environment of exposure (temperature of the field), condition of equipment. Moreover, the absent athletes in each session and the reason of the absence were also recorded in every training and competition sessions during the study period. These data of every sessions were recorded in the 'general status of session' form (see appendix C). The researcher filled this information. The severity of injury and participation hour were calculated. The number of time lost in hour with cause of injuries will determine the severity of each injury. Sum of session hours of each subject was participation hour.

Areas, mechanisms, type and number of injuries had registered in the 'injury form' when injuries occurring (see appendix D). This form also recorded time of injury, initial treatment, consequence of injury and history of previous symptoms. Each injury in all subjects summed to obtain the number of injuries. The consequence in each injury considered whether the athlete 1) be able to continue session, 2) be able to continue after rest and 3) not be able to continue that session, will be recorded. The time lost and consequences used to describe the severity of injuries.

Mechanisms of injuries were divided in acute injury and overuse injury. Acute injury is commonly caused by single event that athlete can describe in detail how the injury occurred. It is produced from direct loading to the area. The tissues are damaged when rapidly applied loads produce strain beyond which tissues can tolerate. In the

other hand, athlete can not describe overuse injury in detail of the occurrence of this repetitive injury. This injury is produced from chronic cyclic activities, which enhanced low repetitive with high-magnitude load of high repetitive with low magnitude load to the area.

Post study period (the end of the tournament), all parameters; incidence rate, severity, area, type and mechanism of injuries were analyzed by using descriptive statistics. The estimated risk factors might be predicted.

3.6 Data Analysis

Incidence rate, severity, area, type and mechanism of injuries will be determined.

3.6.1 Incidence rate

Incidence rate was determined by this formula (3):

$$\text{Incidence rate} = \frac{\text{Number of injuries} \times 1000}{\text{Participation hours}}$$

Number of injuries was sum of injuries in all subjects. Previous injuries, detected by questionnaire 'status of previous injury', did not included in this calculation.

Participation hours were calculated from the sum of athlete's session hours, which all subjects participated. The participation hours did not include the session period which athletes were absent.

This rate was reported in number of injuries per 1000 player-hour. The incidence was calculated in each position in team and also in each type of sessions (practice and competition).

3.6.2 Severity of injuries

Total time lost from sport activities of all injured subjects used to numerate in unit of hour. The consequence of injuries was determined. The level of injuries considered as 1) not miss sport activities or no time lost, 2) time lost less than 1 week and 3) time lost over 1 week. Number of injuries in each level of severity was determined.

3.6.3 Area of injuries

The numbers of injuries in each area were determined. These numbers had demonstrated with severity, type and mechanism of injuries.

3.6.4 Type of injuries

Numbers of injuries in each type of injury were determined. These types of injuries were determined with area, severity and mechanism of injuries.

3.6.5 Mechanism of injuries

Mechanism of injuries classified into 2 categories as traumatic disruption or acute injury and overuse or repetitive injury. Numbers of injuries in each category were determined. In acute injury, the activities during injury were described and categorized as number of injuries. The overuse injury also categorized as number

of injuries although these injuries could not describe activities during injury. These numbers also inspected with area, type and severity of injuries.

Study Period

The first day of study period

Form & instrument	Data Obtained
Questionnaire: Status of previous injury	1. Area 2. Mechanism 3. Severity 4. Previous treatment
Form: Personal information	1. Name-surname 2. Age 3. Height-weight 4. Experience 5. Position in team 6. Other disease 7. Personal equipment 8. Dominant site 9. Gross flexibility 10. Visible deformity 11. Passive range of motion

Post study period

Data Analysis
1. Incidence
2. Severity of injuries
3. Area of injuries
4. Type of injuries
5. Mechanism of injuries

During Study period

Form & Instrument	Time of Collection	Data Obtained
Form: General status of session	Every practice and game sessions	1. Program training 2. Length of session hour 3. Type of session 4. Team ranking in the game session 5. Environment of exposure 6. Condition of equipment 7. Absent athletes with reason
VDO recorder	Sampling record	Sample sport activities
Form: Injury form	Injury occur	1. Area of injury 2. Type of injury 3. Mechanism of injury 4. Consequence of injury 5. Initial treatment 6. Previous symptoms and its history 7. Time of injury

Figure 3.1 Procedure of this study.

CHAPTER IV

RESULTS

4.1 Characteristics of Subjects

Twelve male athletes aged between 21 and 34 years participated in this study. Their experiences in Sepaktakraw were between 10 and 23 years. The positions in team were 4 servers, 3 feeders and 5 attackers. Their weights and heights were 54-72 kg. and 160-184 cm., respectively. All athletes were in the training camps, which were set by staff coach. Athletes used the protective devices such as ankle support, knee supports, long socks, high-top shoes, low-top shoes and sport tape as personal equipment (see appendix).

At the first day of study, there were 5 athletes who had symptoms at knee, hip, low back, wrist and foot. However, they could participate in the sport activities. Therefore, they were included as non-injured athletes at the beginning in the present study. This means all athletes in the national Sepaktakraw team participated in this present study.

4.2 Characteristics of Training

The practice sessions were twice per day (approximately 3 hours per session). The exposure time during practice of all athletes was 3864 hours. They had trained at

indoor stadium of Ayutthaya sport complex for 48 days, Hua Mak sport complex for 15 days and Had Yai sport complex for 6 days.

The characteristics of training included warm-up, training and cool-down periods. At training period, it was not only specific Sepaktakraw training, but aerobic training was also included. Warm-up included stretching, agility and basic Sepaktakraw activities for 30 minutes by average. For cool-down period, athletes had stretching and some agility activities for 10-15 minutes. During training, ball and net were usually ready to use, but the area around service circle was damaged by training.

4.3 Characteristics of Competition

The competitions were consecutive 10 days (5 days for Team event and 5 days for Regu event). The competitions of Team event consisted of 5 matches during 7-12 December 1998 (one day out of competition for transportation between venues of competition) and 8 matches of Regu event during 13-17 December 1998. Time of the game in Team event was 20-60 minutes per game and 20-90 minutes per game in Regu event. The total exposure time during competition of all athletes was 39.5 hours (13 matches). There were 3 substitutions in Team event whereas not any substitution was done during Regu event. The total competition times of all athletes were 24.5 hours in Team event and 15 hours in Regu event. During tournament, the competitions usually were in the afternoon to evening in indoor stadium. In the morning each day, the athletes had gentle training to prepare themselves before competition in the afternoon.

4.4 Incidence Rates

Fifty-three injuries were found in 10 athletes in 3,903 hours and 30 minutes of total exposure time. Incidence rate was 13.58 injuries per 1,000 player-hour.

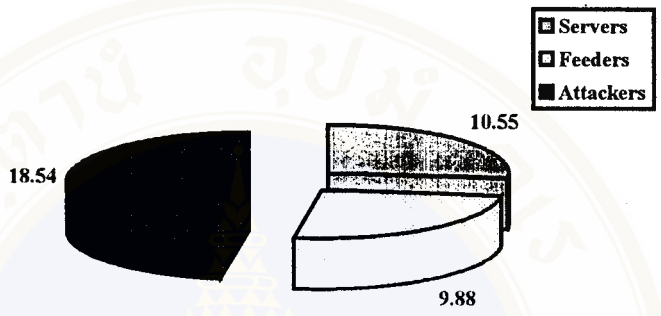
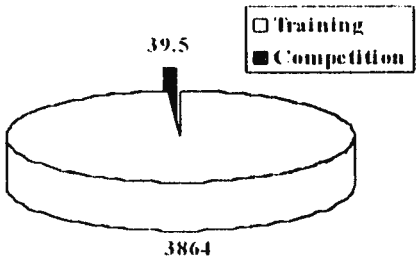
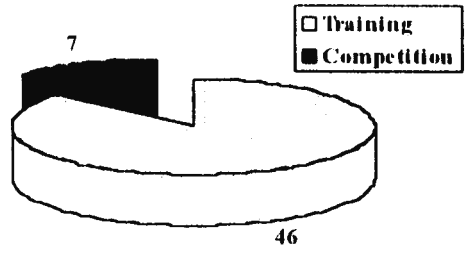


Figure 4.1 Incidence rate in each position in team (injuries/1,000 player-hour).

Fourteen injuries were found in servers (10.55 injuries per 1,000 player-hour), 10 injuries in feeders (9.88 injuries per 1,000 player-hour) and 29 injuries in attackers (18.54 injuries per 1,000 player hour) (figure 4.1).



A:Participation time (hours)
total = 3903.5 hours



B:Number of injuries during each type of sessions: n= 53

C: Incidence rate in each type of sessions
(injuries/1,000 player-hour)
total = 13.58 injuries per 1,000 player-hour

Figure 4.2 The calculation of incidence rate (C) by ratio of number of injuries (B) and participation time (A).

Forty-six injuries occurred during practice (11.90 injuries per 1,000 player-hour). Seven injuries occurred during competition (177.22 injuries per 1,000 player-hour). In 5 matches of Team event, 12 athletes of the 3 teams played in the games for 1,470 minutes had 3 injuries (122.45 injuries per 1,000 player-hour). In 8 matches of Regu event, 4 athletes played in the games for 900 minutes had 4 injuries (266.67 injuries per 1,000 player-hour).

4.5 Previous Symptoms and Injuries

Form all 53 injuries, 28 injuries did not have previous symptoms at the same area of injuries whereas 25 injuries had previous symptoms (see table 4.1).

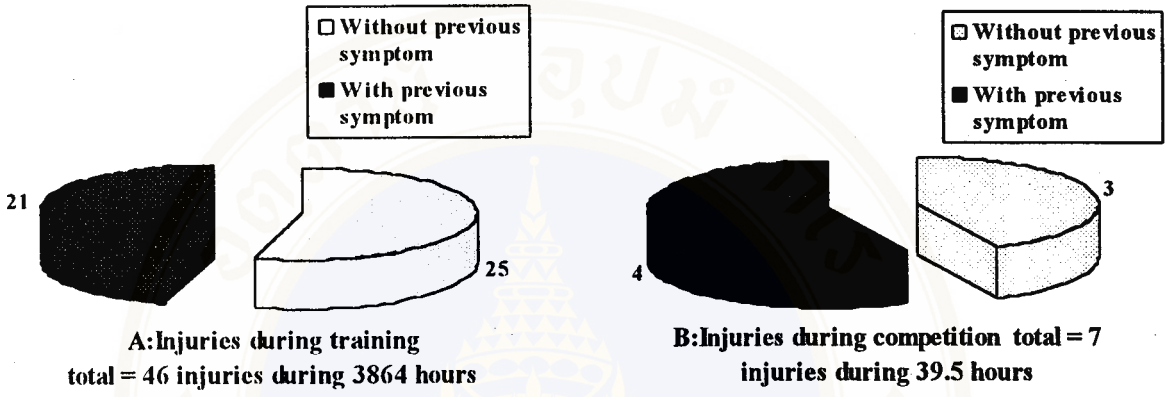


Figure 4.3. Injuries during training and competition with and without previous symptoms.

For all 46 injuries during training, 25 injuries did not have previous symptom and 21 injuries had previous symptoms. From seven injuries during competition, 3 injuries did not have previous symptoms but 4 injuries had previous symptom (see figure 4.3).

Table 4.1 Numbers of injuries by position in team, time of injury, period of injury and previous symptoms in each areas.

Area	Position in Team			Time of Injury		Period of Injury				Previous Symptoms	
	Back	Attacker	Feeder	Practice	Competition	Warm -up	Tech./ game	Cool- down	Other/not specify	Yes	No
Head/neck	1	3	-	4	-	1	2	-	1	2	2
Ear	-	-	1	-	1	-	1	-	-	-	1
Shoulder	-	4	-	2	2	-	4	-	-	2	2
Upper back	-	1	-	1	-	-	1	-	-	-	1
Lower back	-	-	1	1	-	-	-	-	1	1	-
Coccyx	-	1	-	-	1	-	1	-	-	-	1
Hip	4	1	2	4	3	-	7	-	-	5	2
Groin	2	-	1	3	-	1	2	-	-	1	2
Ant. Thigh	1	3	1	5	-	-	4	-	1	2	3
Post. Thigh	1	2	-	3	-	-	3	-	-	-	3
Med. Thigh	-	1	-	1	-	-	1	-	-	-	1
Knee	1	4	2	7	-	1	5	-	1	6	1
Leg	-	4	-	4	-	-	1	-	3	1	3
Ankle	1	5	2	8	-	-	6	1	1	4	4
Foot	1	-	-	1	-	-	1	-	-	1	-
Toes/Bigtoes	2	-	-	2	-	-	2	-	-	-	2
Total	14	29	10	46	7	3	41	1	8	25	28

Ant.thigh = Anterior thigh Post.thigh = Posterior thigh Med.Thigh = Medial thigh

Table 4.2. Duration of previous symptoms before present injuries

Duration of previous symptom	Number of injuries
< 1 weeks	1
1-4 weeks	9
1-6 months	7
6 months <	6
Not specified	2

For 25 out of 53 injuries which had previous symptoms, 1 injury had duration of previous symptoms during 1 week, 9 injuries had during 1-4 week, 7 injuries had during 1-6 months and 6 injuries had over 6 months before detected injuries. There were 2 injuries that athletes could not specify duration of previous symptoms (see table 4.2).

Table 4.3. Repeated injuries in athletes

No. of athlete	Duration 1st-2nd injury (day)	Area	Consequences of injuries		Mechanism		Symptoms of 1st at 2nd event
			1st	2nd	1st	2nd	
1	12	shoulder	C	C	acute	overuse	all time
2	21	knee	C	C	acute	overuse	sometime
3	14	anterior thigh	C	D	acute	acute	not have
4	27	neck	D	D	acute	overuse	sometime
5	18	hip	C	C	acute	overuse	sometime

1st = first injury of the couple 2nd = second injury of the couple
C = can continue activities that session D = can not continue activities that session

However, this present study recorded in 5 athletes who had repeated injuries during study period (see table 4.3). Repeated injuries in this study mean subjects had at least two injuries of the same specific area during the study period. Duration between the first injuries and second injuries were 12-27 days. All first injuries were acute whereas the second injuries were 1 acute and 4 overuse.

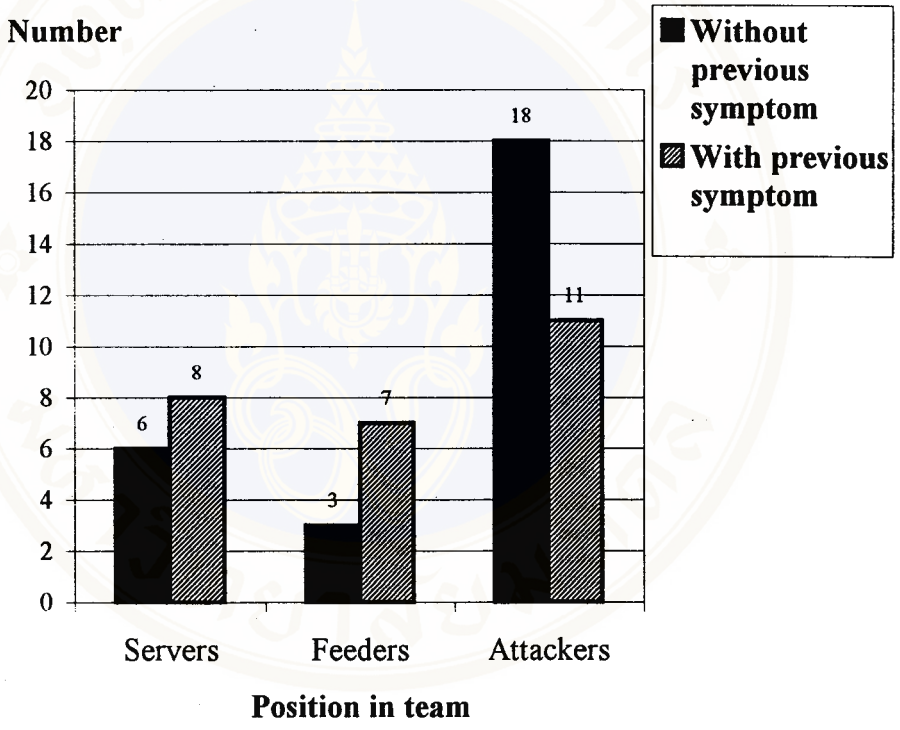


Figure 4.4 Number of injuries in each position in team with and without previous symptoms.

For previous symptoms of each position in team, not only 8 of 14 injuries in servers had previous symptoms, 7 of 10 injuries in feeders and 11 of 29 injuries in attackers also had previous symptoms (see figure 4.4).

4.6 Severity of Injuries

Levels of severity were classified by whether athlete could continue their activities in 3 levels; continue, resting before continue and discontinue activities. Majority of injuries did not disturb athletes' sport activities. All injuries that had time loss less than 1 week.

Table 4.4 Severity of injuries in all athletes

Area	Severity of injury			Total
	Continue	Resting before continue	Discontinue	
Head/neck	1	1	2	4
Ear	-	1	-	1
Shoulder	4	-	-	4
Upper back	-	-	1	1
Lower back	1	-	-	1
Coccyx	1	-	-	1
Hip	7	-	-	7
Groin	2	-	1	3
Ant.thigh	4	-	1	5
Post.thigh	3	-	-	3
Med.thigh	1	-	-	1
Knee	5	1	1	7
Leg	3	-	1	4
Ankle	5	2	1	8
Foot	1	-	-	1
Toes/Bigtoes	2	-	-	2
Total	40	5	8	53

Ant.thigh = Anterior thigh Post. Thigh = posterior thigh Med.thigh = Medial thigh

Table 4.5 Number of player-hour loss in next sessions after injury which athlete discontinue activities (n = 6)

Area	Number	Time of Absent
Head/neck	2	3, 18 hr.
Upper Back	1	9 hr.
Groin	1	3 hr.
Leg	1	12 hr.
Ankle	1	15 hr.

hr. = player-hour lost

For 40 of 53 injuries, athletes could continue their activities without resting as shown in table 4.4. Five injuries made athletes to rest between 1 and 20 minutes before returning to activities. Eight injuries made athletes discontinue the practice or competition sessions. Form table 4.5, six of eight injuries made athlete discontinue activities, that is athletes were absent in the next practice or competition session for 3-18 player-hour whereas 2 injuries did not have affect on the participation of athletes. Neck muscle strain produced 18 player-hour loss (see tables 4.4 and 4.5). Total times loss were 60 hours and 30 minutes for all injuries.

Table 4.6 Severity of injuries and mechanisms of injuries

Mechanism of Injury		Severity of Injury			Total
		Continue	Resting before continue	Discontinue	
Acute injury	Serving	4	-	-	4
	Feeding	2	-	-	2
	Attacking	11	1	2	24
	Blocking	3	1		4
	Other	-	3	5	8
	Not specify	1	-	-	1
Overuse injury		19	-	1	20
Total		40	5	8	53

Table 4.7 Time of resting before continue activities after injury in each mechanism (n= 5)

Mechanism of Injury		Number	Time of Resting
Acute injury	Attacking	1	20 min.
	Blocking	1	1-2 min.
	Other	3	1,2,5 min.

Table 4.8 Number of player-hour loss in next sessions after injury which athlete discontinue activities in each mechanism (n = 6)

Mechanism of Injury		Number	Time of Absence
Acute injury	Attacking	2	9,18 hr.
	Other	4	3,3,12,15 hr.

Twenty-one acute injuries did not produce time loss after injuries whereas 12 acute injuries produced time loss after injuries (see table 4.6). Five acute injuries needed rest 1-20 minutes before returning activities as shown in table 4.7. From table

4.8, six acute injuries produced athletes's absence in the next sessions for 3 to 18 player-hour.

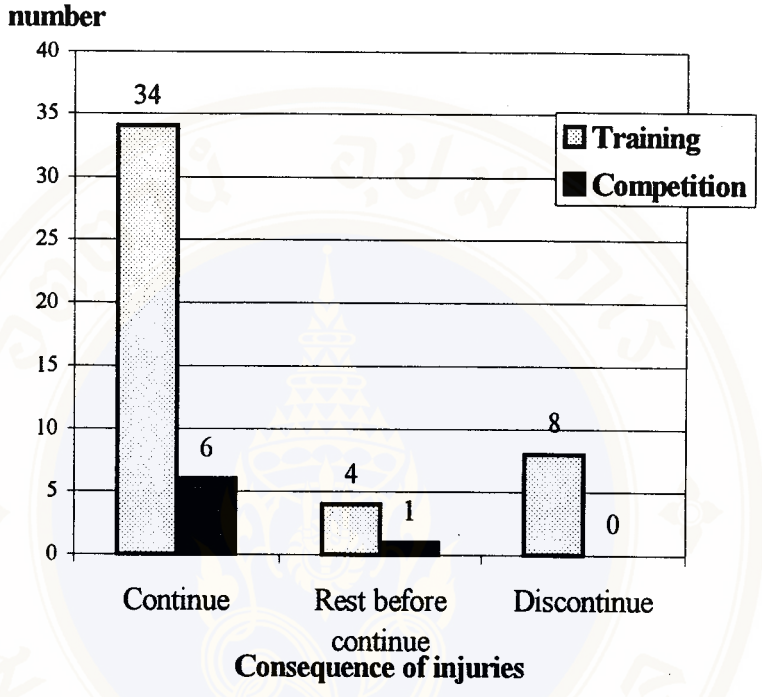


Figure 4.5 Severity of injuries during training and competition.

For 36 of 46 injuries during practice sessions, athletes could continue their activities in that session, 4 injuries need to rest before return to sport activities and 8 injuries made athletes discontinue the sessions (see figure 4.5). During competitions, only 1 injury produced 1 minute lost before returning to the competition.

4.7 Area of Injuries

Sport activities during this present study produced 53 injuries in 16 areas.

Table 4.9 Area of injuries in each mechanism of injury

Area	Mechanisms of Injuries							Total
	Acute Injury						Overuse Injury	
	Serving	Feeding	Attacking	Blocking	Other	Not specify		
Head/neck	-	-	1	1	1	-	1	4
Ear	-	-	-	-	1	-	-	1
Shoulder	-	-	3	-	-	-	1	4
Upper back	-	-	1	-	-	-	-	1
Lower back	-	-	-	-	-	-	1	1
Coccyx	-	-	1	-	-	-	-	1
Hip	2	-	1	-	-	1	3	7
Groin	1	-	1	-	1	-	-	3
Ant.thigh	1	-	1	1	1	-	1	5
Post.thigh	-	-	3	-	-	-	-	3
Med.thigh	-	-	-	1	-	-	-	1
Knee	-	1	1	1	1	-	3	7
Leg	-	-	-	-	1	-	3	4
Ankle	-	1	1	-	2	-	4	8
Foot	-	-	-	-	-	-	1	1
Toes/Bigtoes	-	-	-	-	-	-	2	2
Total	4	2	14	4	8	1	20	53

Ant.thigh = Anterior thigh
Post.thigh = Posterior thigh
Med.thigh = Medial thigh

From table 4.9, there were 16 areas of injuries as 4 head/neck injuries, 1 ear injury, 4 shoulder injuries, 1 upper back injury, 1 lower back injury, 1 coccyx injury, 7

hip injuries, 3 groin injuries, 5 anterior thigh injuries, 3 posterior thigh injuries, 1 medial thigh injury, 7 knee injuries, 4 leg injuries, 8 ankle injuries, 1 foot injury and 2 toe/bigtoe injuries (see tables 4.1 and 4.9). The 7 injuries during competition were at ear (1 injury:laceration), shoulder (2 injuries:strain), hip (3 injuries:soreness) and coccyx (1 injury:contusion).

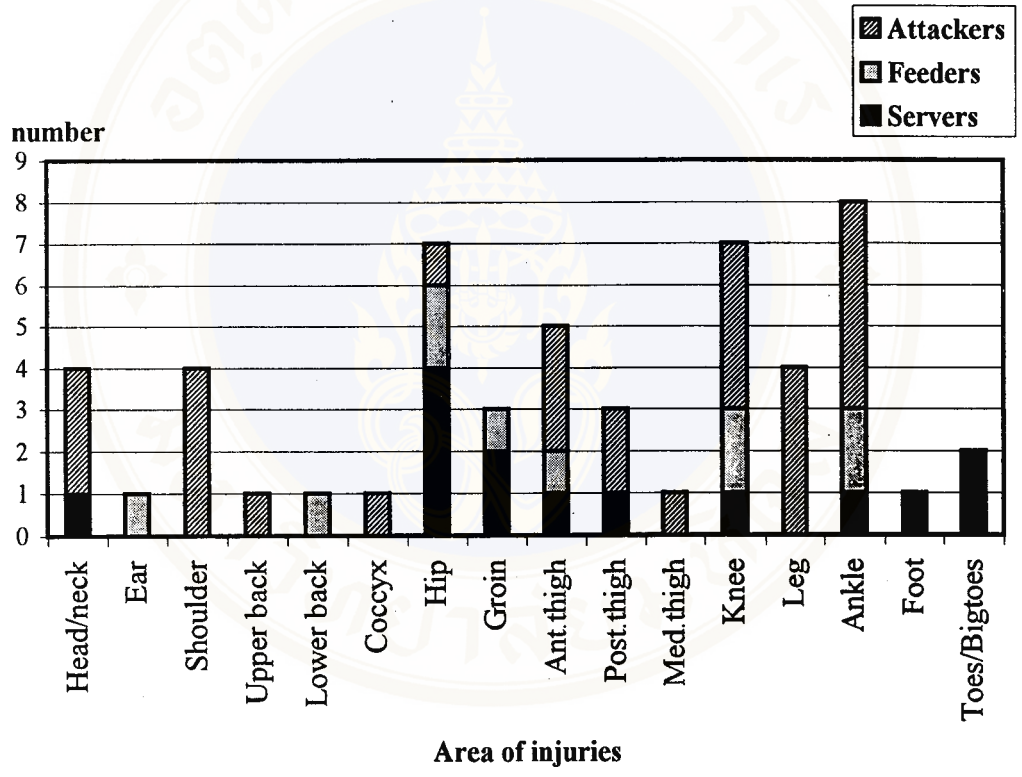


Figure 4.6. Area of injuries in each position in team.

There were 1 ear injury, 1 low back injury, 2 hip injuries, 1 groin injury, 1 anterior thigh injury, 2 knee injuries and 2 ankle injuries in feeders. In servers, there were 1 neck injury, 4 hip injuries, 2 groin injuries, 1 anterior thigh injury, 1 posterior thigh injury, 1 knee injury, 1 ankle injury, 1 foot injury and 2 toes injuries. Injuries in

attackers were 3 neck injuries, 4 shoulder injuries, 1 upper back injury, 1 coccyx injury, 1 hip injury, 3 anterior thigh injuries, 1 medial thigh injury, 2 posterior thigh injuries, 4 knee injuries, 4 leg injuries and 5 ankle injuries (see figure 4.6).

4.8 Type of Injuries

There were 37 muscle and tendon injuries, 10 joint and structure injuries, 3 skin injuries and 3 other soft tissue injuries. Majority of injuries was strain (20 injuries) followed by sprain (10 injuries), spasm (8 injuries), soreness (5 injuries), tendinitis (3 injuries), blister (2 injuries), laceration (1 injury), contusion (1 injury) and other injuries (3 injuries). All five anterior thigh injuries were strain. Majorities of strain were produced at thigh, neck and hip. Sprain usually found at ankle (see table 4.10).

Table 4.10 Type of injuries in each area

Area	Type of Injury									Total (No.)
	Muscle and Tendon					Joint Structure	Skin Injury		Other Injury	
	strain	spasm	soreness	contusion	tendinitis	sprain	blister	laceration		
Head/neck	3	-	1	-	-	-	-	-	-	4
Ear	-	-	-	-	-	-	-	1	-	1
Shoulder	3	1	-	-	-	-	-	-	-	4
Upper back	1	-	-	-	-	-	-	-	-	1
Lower back	-	1	-	-	-	-	-	-	-	1
Coccyx	-	-	-	1	-	-	-	-	-	1
Hip	3	-	3	-	-	1	-	-	-	7
Groin	2	1	-	-	-	-	-	-	-	3
Anterior thigh	5	-	-	-	-	-	-	-	-	5
Posterior thigh	1	2	-	-	-	-	-	-	-	3
Medial thigh	1	-	-	-	-	-	-	-	-	1
Knee	-	1	-	-	-	4	-	-	2	7
Leg	1	2	1	-	-	-	-	-	-	4
Ankle	-	-	-	-	3	5	-	-	-	8
Foot	-	-	-	-	-	-	-	-	1	1
Toes/Bigtoes	-	-	-	-	-	-	2	-	-	2
Total (No.)	20	8	5	1	3	10	2	1	3	53

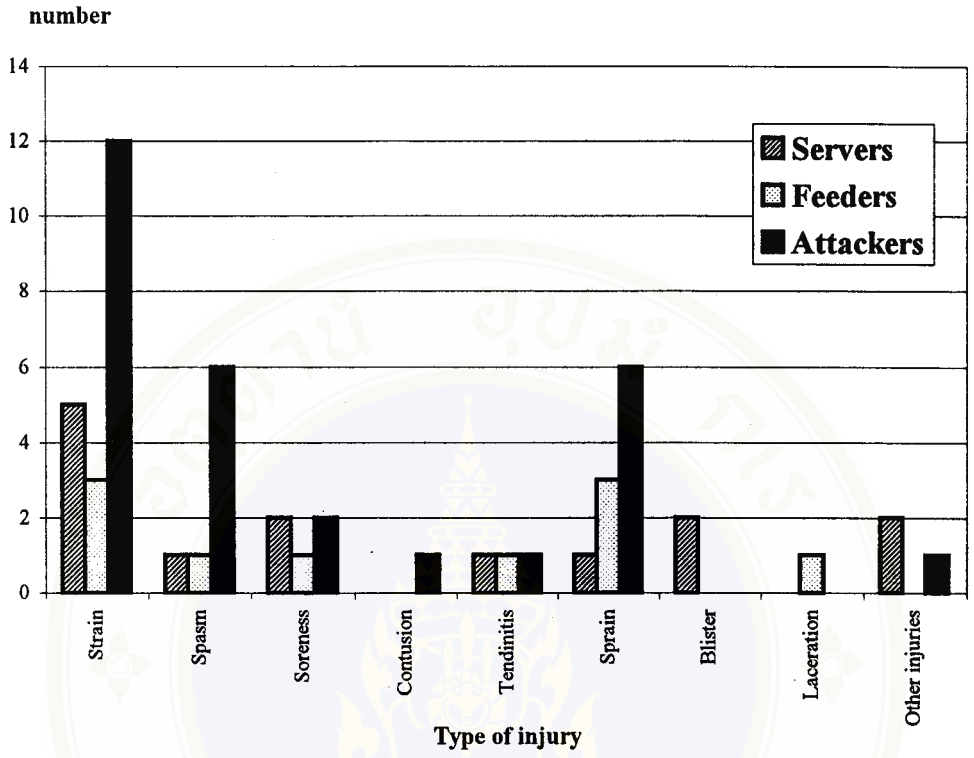


Figure 4.7 Type of injuries in each position in team

Twelve strains were found in attackers followed by servers. Majority of spasm and sprain were also found in attackers (see figure 4.7).

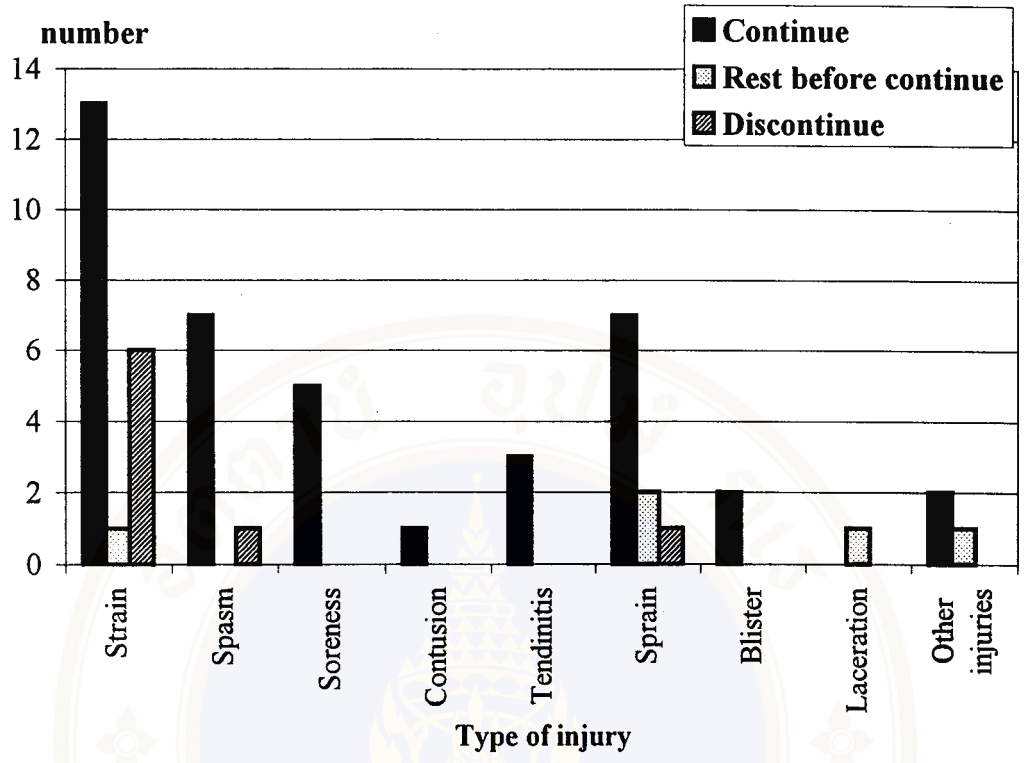


Figure 4.8 Severity of injuries in each type of injuries

Generally, severity of injuries in each type were not so caustic, that is most athletes could return to their activities. However, in strain, seven out of twenty strain injuries forced athletes to discontinue their practice or competition (see figure 4.8).

From table 4.11, eighteen out of twenty strains were acute whereas 2 injuries were overuse injury. Eight acute strains occurred during attacking, 3 strains during blocking and 2 strain during serving. Four of 8 spasms were overuse injury and all 5 soreness and 3 tendinitis were also overuse injury. Four acute sprains occurred while attacking and feeding. There were 2 sprains as overuse injury.

Table 4.11 Mechanism of injuries in each type of injuries

Mechanisms		**Type of Injury**									
		Muscle and Tendon					**Joint Structure**	**Skin Injury**		**Other Injury**	**Total** (No.)
		strain	spasm	soreness	contusion	tendinitis	sprain	blister	laceration		
Acute injury	serving	2	1	-	-	-	1	-	-	-	4
	feeding	-	-	-	-	-	2	-	-	-	2
	attacking	8	3	-	1	-	2	-	-	-	14
	blocking	3	-	-	-	-	1	-	-	-	4
	other	4	-	-	-	-	2	-	1	1	8
	not specify	1	-	-	-	-	-	-	-	-	1
Overuse injury		2	4	5	-	3	2	2	-	2	20
Total (No.)		20	8	5	1	3	10	2	1	3	53

4.9 Mechanisms of Injuries

For fifty-three injuries, there were 33 acute injuries (62.27%), 20 overuse injuries (37.73%).

Table 4.12 Mechanisms of injuries in each position in team

Position in Team	Mechanism of Injuries							Total
	Acute injury						Overuse Injury	
	serving	feeding	attacking	blocking	other	not specify		
Attacker	-	-	11	4	4	1	9	29
Feeder	-	2	2	-	1	-	5	10
Back	4	-	1	-	3	-	6	14
Total	4	2	14	4	8	1	20	53

For 33 acute injuries, 4 injuries were found during serving, 2 injuries during feeding, 14 injuries during attacking, 4 injuries during blocking, 8 injuries during other activities and 1 injury could not be specified due to incomplete information (see table 4.1,4.12). Three out of 7 injuries during competition were acute injuries, which were during landing of summersault and sunback, and contact the aggressive ball. Four overuse injuries were also occurred during competition.

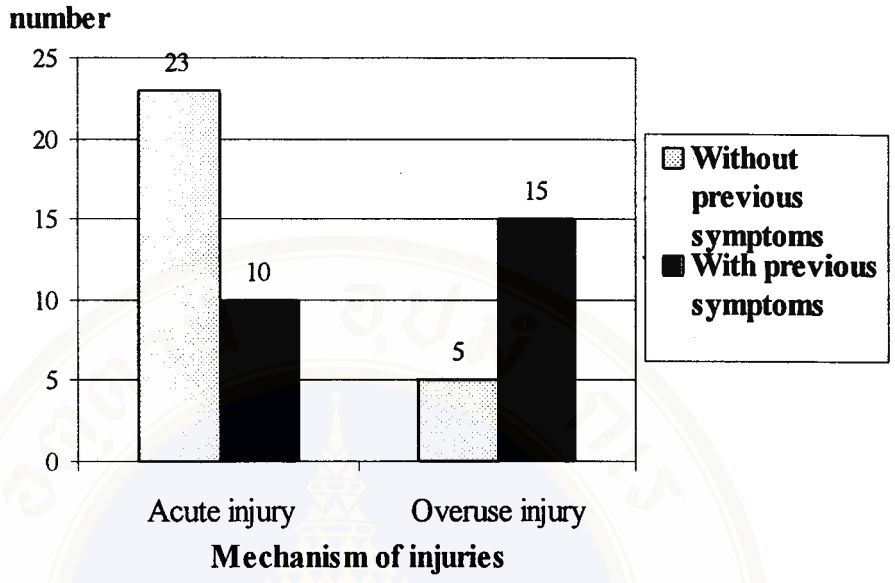


Figure 4.9 Number of acute and overuse injuries with and without previous symptoms.

There were 10 acute injuries and 15 overuse injuries that had previous symptoms whereas 23 acute injury and 5 overuse injury did not have previous symptoms (see figure 4.9). Ten acute injuries had previous symptoms ranged from 11 days to many years before present injuries. Fifteen overuse injuries had previous symptoms from 6 days to 1.5 years before present injuries.

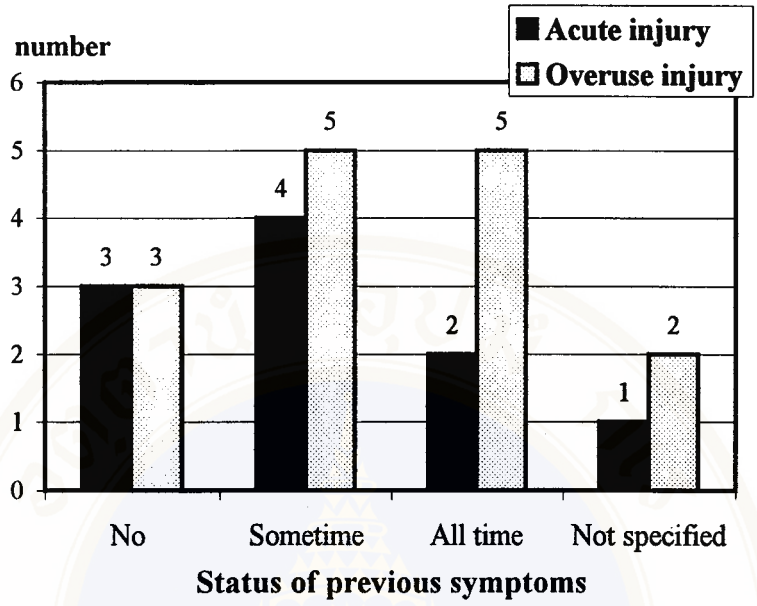


Figure 4.10 Status of previous symptoms during present injuries event in each mechanism of injuries.

From figure 4.10, the previous symptoms of 15 present overuse injuries were absent in 3 injuries, 5 injuries had occasionally symptoms and 5 injuries had symptoms all the time. Two injuries were still not specified. Three present acute injuries did not have the previous symptoms, whereas 4 present acute injuries had occasionally previous symptoms. Two present acute injuries had previous symptoms at all time.

4.9.1 Acute injuries during serving

From 33 acute injuries, 4 acute injuries were produced during serving.

Table 4.13 Details of acute injuries during serving

No.	Position in team	Area	Time of injury	Previous symptoms	Severity of injury	Type of injury
1	server	anterior thigh	tech./ practice	no	continue	strain
2	server	groin	tech./ practice	no	continue	spasm
3	server	hip	tech./ practice	yes	continue	strain
4	server	hip	tech./ practice	yes	continue	sprain

tech./practice. = Sepaktakraw technique activities during practice session
tech./compet. = Sepaktakraw technique activities or game during competition session

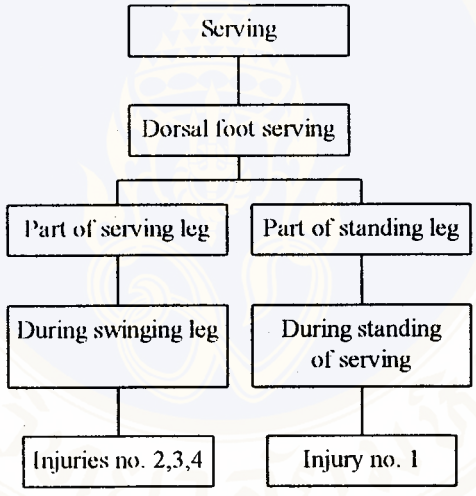


Figure 4.11 Mechanism of injuries during serving.

Serving produced 4 injuries that were 2 strain, 1 spasm and 1 sprain in 2 servers (see table 4.13). All injuries were produced during serving by dorsum of foot. These were 3 injuries in serving leg and 1 injury in standing leg. All 3 injuries in serving leg were produced during swing the leg, and one injury was produced at standing leg while standing of serving (see figure 4.11). The injuries in swinging leg were strain of gluteus medius muscle, spasm of rectus femoris muscle and pain at

structure around hip joint. Standing leg had strain at vastus lateralis muscle. However, these 4 injuries did not disturb sport activities of athletes.

4.9.2 Acute injuries during feeding

Two out of 33 acute injuries occurred during feeding.

Table 4.14 Details of acute injuries during feeding

No.	Position in team	Area	Time of injury	Previous symptom	Severity of injury	Type of injury
1	feeder	knee	tech./ practice	yes	continue	sprain
2	feeder	ankle	tech./ practice	yes	continue	sprain

tech./practice. = Sepaktakraw technique activities during practice session
tech./compet. = Sepaktakraw technique activities or game during competition session

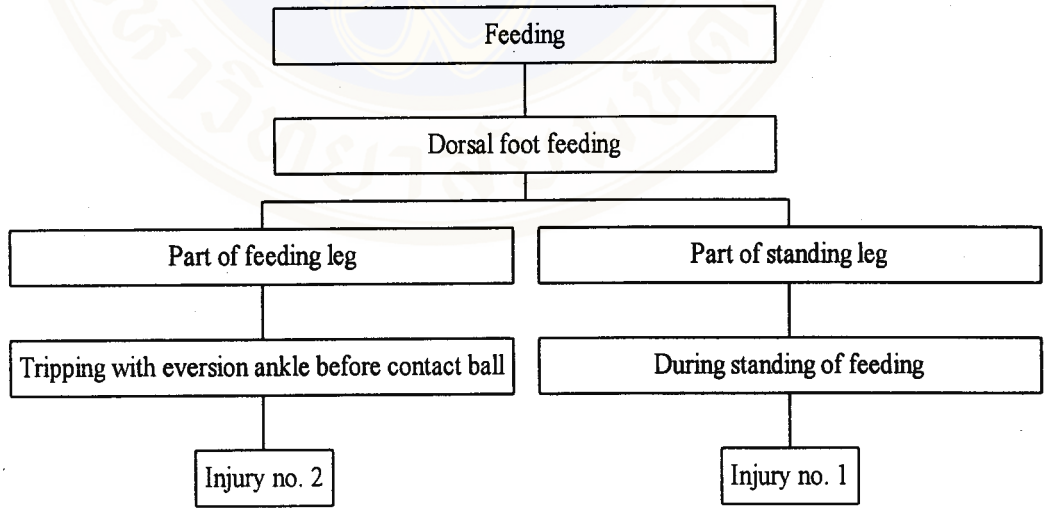


Figure 4.12 Mechanism of injuries during feeding.

Feeding produced 2 injuries that were 2 sprain (ankle sprain and knee joint injury) in 2 feeders (see table 4.14). These were feeding by dorsum of foot, which one was injury at part of standing leg and another was at part of feeding leg (see figure 4.12). Injury at part of standing leg was knee joint injury. Injury at feeding leg produced ankle sprain. The ankle was in eversion during following the ball then stripping before touch the ball. However, these 2 injuries did not produce time loss from sport activities.

4.9.3 Acute injuries during attacking

The majority of acute injury occurred during attacking. Fourteen out of 33 acute injuries produced while attacking.

Table 4.15 Details of acute injuries during attacking

No.	Position in team	Area	Time of injury	Previous symptoms	Severity of injury	Type of injury
1	attacker	ankle	tech./ practice	no	rest before continue	sprain
2	attacker	post.thigh	tech./ practice	no	continue	spasm
3	attacker	coccyx	tech./compet.	no	continue	contusion
4	attacker	shoulder	tech./compet.	no	continue	strain
5	attacker	shoulder	tech./practice	no	continue	strain
6	attacker	post.thigh	tech./practice	no	continue	spasm
7	attacker	shoulder	tech./practice	yes	continue	spasm
8	attacker	knee	tech./practice	no	continue	sprain
9	server	post.thigh	tech./practice	no	continue	strain
10	feeder	hip	tech./practice	no	continue	strain
11	attacker	neck	tech./practice	no	discontinue	strain
12	attacker	upper.back	tech./practice	no	discontinue	strain
13	feeder	groin	tech./practice	no	continue	strain
14	attacker	ant.thigh	tech./ practice	no	continue	strain

tech./practice.-competition = Sepaktakraw technique activities during practice session – during competition

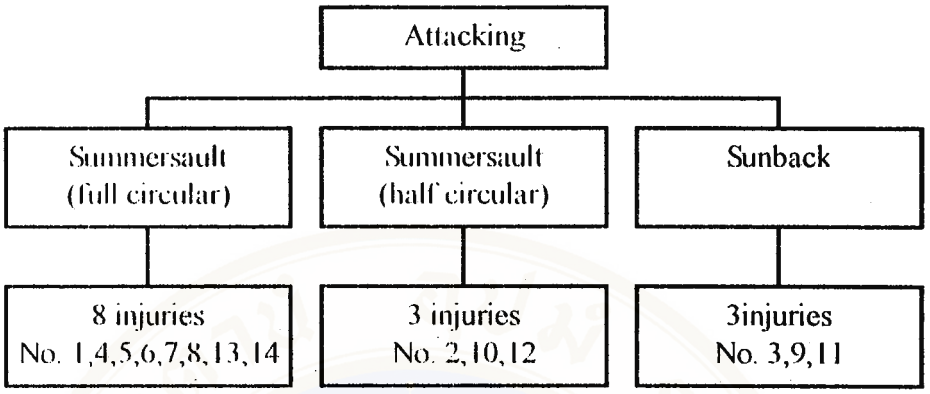


Figure 4.13 Mechanism of injuries during attacking.

Attacking produced 14 injuries that were 8 strains, 3 spasms, 2 sprains and 1 contusion in 4 attackers, 2 feeders and 1 server (see table 4.15). Each athlete demonstrated more than one injury. Eight injuries were produced during full circular summersault, 3 injuries during half-circular summersault and 3 injuries during sunback (see figures 4.13-16).

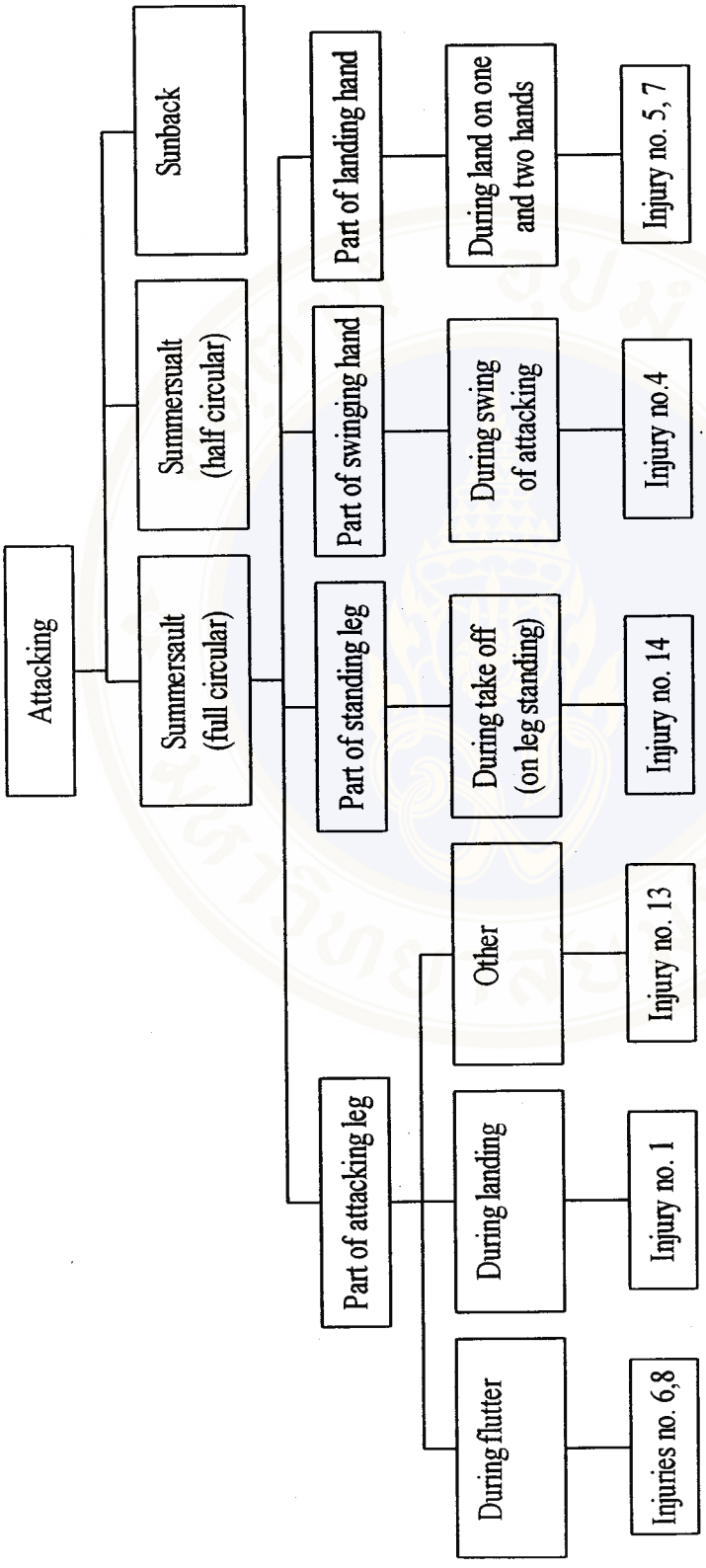


Figure 4.14 Mechanism of injuries during full circular summersault.

From figure 4.14, injuries during full circular summersault were in standing leg (1 injury), attacking leg (3 injuries), swinging hand (1 injury), landing with one hand (1 injury) and landing with two hands (1 injury). The standing leg was injured during take off which was one leg standing on ground. It produced vastus lateralis muscle strain in attacker. The attacking legs were injured during these legs swinging in the air (2 injuries), landing (1 injury) and could not specified position of the leg (1 injury) in 2 attackers. The 2 injuries of attacking legs which fluttered in air were medial collateral ligament sprain (missing touch the ball) and hamstring muscle spasm in 2 attackers. One injury of landing one leg was ankle sprain in attacker and another injury at attacking leg was rectus femoris muscle strain in the feeder. The swinging hand while attacking was strain of deltoid muscle in attacker. Injury during one hand landing was supraspinatus strain in attacker. This landing hand was shoulder extension and internal rotation with elbow full extension, wrist extension and radial deviation. Injury during two hands landing was teres muscles spasm of one shoulder in attacker.

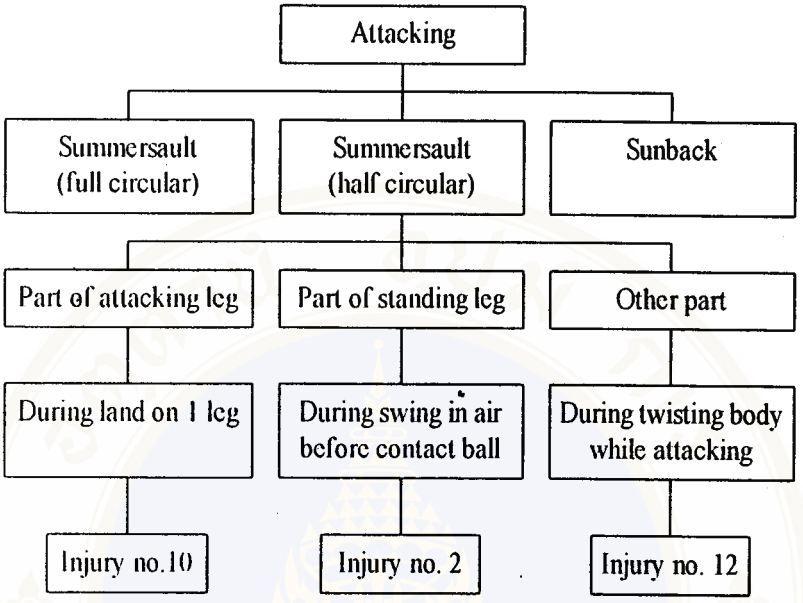


Figure 4.15 Activities of half circular summersault during injuries event.

Injuries during half-circular summersault were in take off leg (1 injury), attacking leg (1 injury) and back (1 injury) as shown in figure 4.15. Piriformis muscle strains occurred during swinging the leg. Injury in attacking leg was produced gluteus maximus spasm in attacker while landing one leg. Back muscle strain in attacker was produced during twisting the trunk in the air.

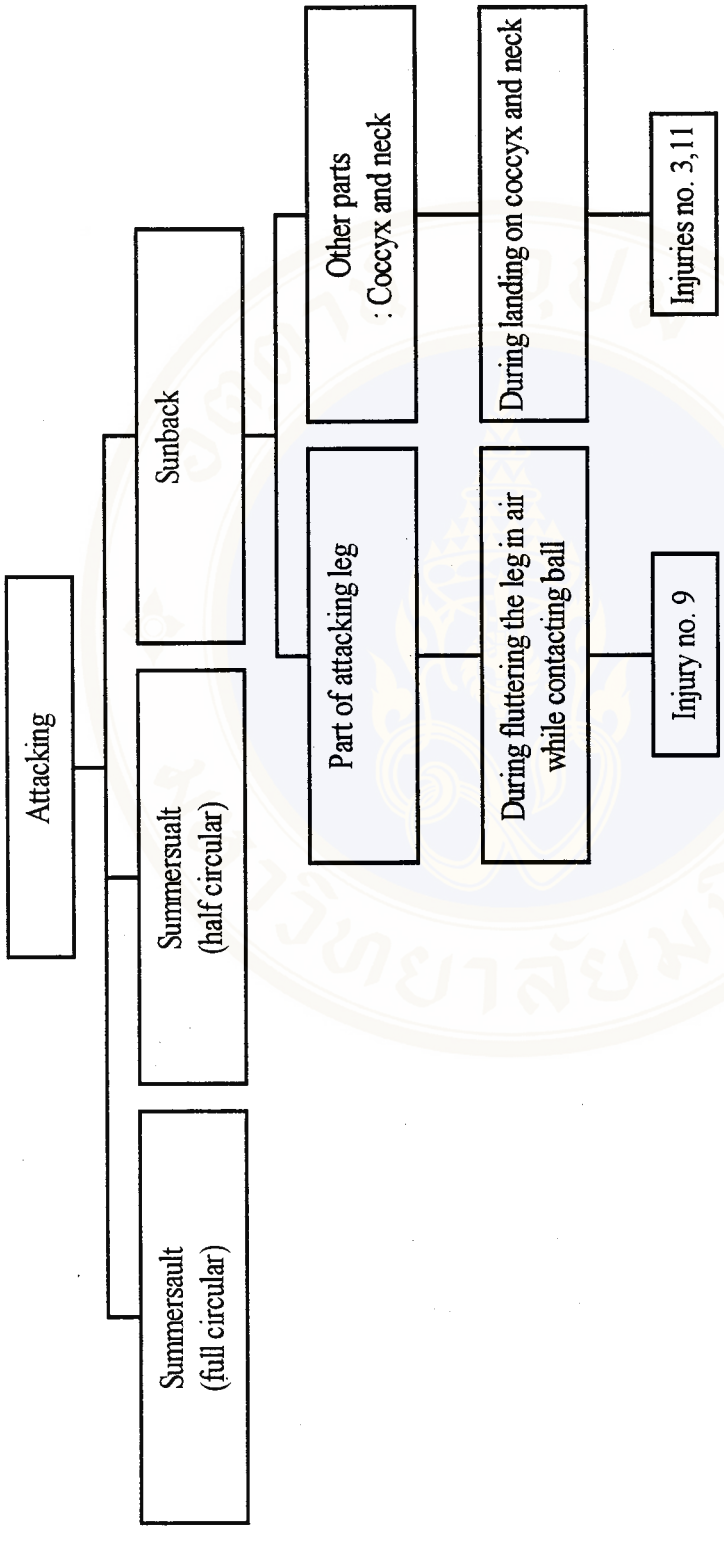


Figure 4.16 Mechanism of injuries during sunback.

From figure 4.16, these were 3 injuries during sunback that were 2 strain and 1 contusion in 2 attackers and 1 server. False landing produce 2 injuries which landing on coccyx (contusion) and head through upper back (neck muscle strain) in attackers. At the maximum point of hip flexion during sunback, adductor femoris muscle strain was produced in attacking leg of server. In addition, the injury while landing on head and upper back produced the highest time lost from activities (18 player-hour).

4.9.4 Acute injuries during blocking

From 33 acute injuries, there were 4 injuries occurred during blocking.

Table 4.16 Details of acute injuries during blocking

No.	Position in team	Area	Time of injury	Previous injury	Severity of injury	Types of injury
1	attacker	medial thigh	tech./ practice	no	continue	strain
2	attacker	head	tech./ practice	yes	rest before continue	strain
3	attacker	anterior thigh	tech./ practice	no	continue	strain
4	attacker	knee	tech./ practice	yes	continue	sprain

tech./practice. = Sepaktakraw technique activities during practice session
tech./compet. = Sepaktakraw technique activities or game during competition session

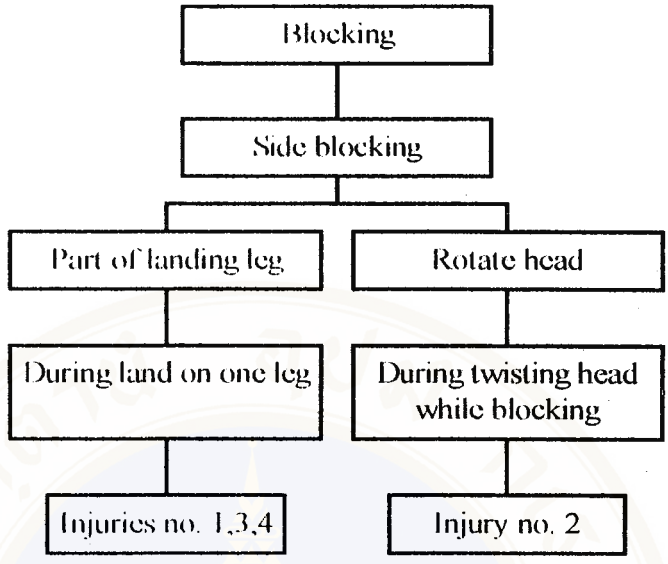


Figure 4.17 Mechanism of injuries during blocking.

Four injuries were produced during blocking in 3 attackers were 3 strain and 1 sprain. Landing one leg which was opposite to the net in side-blocking position, produced 3 injuries (see table 4.16, figure 4.17). Three injuries were rectus femoris strain, adductor femoris strain and lateral collateral ligament sprain. Another injury was upper fiber of trapezius strain during protective head rotation of side-blocking.

4.9.5 Acute injuries during other activities

Eight injuries occurred during other activities. Two ankle sprains were inversion mechanism while playing game during practice sessions (not Sepaktakraw). Two rectus femuris strains were produced during agility training and running follow the ball, which was recurrent strain. One sceleni muscle strain was produced during

warm-up activity. One meniscus injury was produced during curve running and another injury was ear laceration from served ball contusion.

CHAPTER V

DISCUSSION

5.1 Characteristics of Subjects

In this study, 12 athletes participated in training and competition sessions of one tournament. Each athlete has played Sepaktakraw for at least 10 years and followed the program set by staff coach. Generally, the activities in training were similar in every athlete. At the first day of the study, some previous symptoms were found in athletes. Those symptoms would be the result of minor injuries that athletes had judgement to ignore and participate in the training and competition. However, that would be a result of incomplete healing of previous injuries. The decision making to continue activities based on individual pain threshold and tolerance (4,7,21,22). From the method of this study, the definition of injury was the injury which require the medical attention. At the beginning of the study, there was no athlete who reported any injury, therefore, all athletes were included in this study.

5.2 Characteristics of Training and Competition

All athletes had trained twice per day or 6 hours everyday and 6 days per week. This seemed to be intensive training. Athletes had only one day per week to rest or change activities.

Moreover, there was competition everyday during tournament. The competitions were on the afternoon or evening. There was during night and in the morning for resting or proper management for injuries. Hard training and competition would be one of risk factors inducing injuries in Sepaktakraw. Pettrone and Ricciardelli in 1997 (21) found more number of injuries in longer hours than the shorter hours of practice in gymnastics. For training over 2.5 hours per day, over 3 days per week produced higher number of injuries than 1-2 hour per day, 2 days per week. During competitions in this study, there were few substitutions. Therefore, athletes who participated in games usually played the whole time of the games.

5.3 Incidence Rate

The incidence rate of this study was 13.58 injuries per 1,000 player-hour in 12 athletes during training and competition. There were few reports related to number of injuries in national Sepaktakraw team, especially as incidence. Sport Authority of Thailand (SAT) reported number of Sepaktakraw-related injuries in national team during 1983-1986 and 1995-1997. During 1983-1986, SAT found 91 injuries and 66 injuries during 1995-1997, while 53 injuries were recorded during 3 months of this present study. If the incidence of these 3 studies were calculated, the reports of SAT showed less incidence rate of injuries than the present study. This may be due to the method of data collection. The data collection in this present study was recorded day by day, while the SAT data collection were done by gathering the number of athletes who were willing to come to the SAT clinic. This would lead to the higher number of recorded injuries in this present study. In addition, the data of all injuries in SAT reports would be referred to the Sepaktakraw association that influenced chances of

participation in international tournaments of athletes. Therefore, some of the injured athletes did not want to go to the clinic of SAT. Therefore, the injuries, which were recorded by SAT, would be under estimated.

Positions in team affected the number of injuries. This study found different numbers of injuries in each position. Incidence of injuries in attackers was higher than feeders and servers, this is because attackers activities were greater than other positions. The attackers usually attacked and blocked in the game, whereas the servers and feeders rarely performed those movements. The attacking and blocking were more aggressive than serving and feeding. Therefore, greater number of injuries was in attackers as shown in table 4.12 and figure 4.6.

This Sepaktakraw study found higher incidence of injuries during competitions than those in practices, although the number of injuries during practice were more than that of during competitions. Incidence of injuries in this study was calculated as ratio between number of injuries per participation time. Therefore, short duration of total competition period produced higher incidence. Moreover, there would be the effect of intensive activities and less substitution during short period of competitions that produced higher incidence (7 injuries within 39.5 hours). The similar results were found in the studies of soccer (10) and gymnastics (19), which higher incidence of injuries during competition than during training period was found.

5.4 Previous Symptoms of Injuries

From tables 4.1-2, and figure 4.3, many injuries (25 in 53 injuries) had previous symptoms. It is possible that the healing process of previous injuries which athlete ignored them would be incomplete. The result of this study showed that previous symptoms may be one of risk factors (7,28) which athletes should be aware of. This means that previous symptoms would lead to injuries in the future.

The duration of previous symptoms before present injuries was less than 1 week to over 6 months (table 4.2). The majority of the duration was 1-4 weeks, which was within the study period. Only five couples of repeated injuries were recorded (table 4.3). This means that previous symptoms were produced from minor injuries and did not disturb ability of athlete at that duration. The injured athletes ignored those minor injuries and did not request medical treatment. The injured athlete could tolerate and continue their activities. That tolerance produced reinjury in athletes. Moreover, the injury definition of this present study was injury that needs medical attention. Therefore, those minor injuries, which produced previous symptoms, were not recorded. The ignorance of injury management makes those injured athletes who had previous symptom before present injuries, to neglect those minor injuries.

5.5 Severity of Injuries

The majority of injuries in this study did not produce time loss from activities as shown in tables 4.5-6 and figure 4.5. In this study, the severity of injury was determined by duration of time loss. From table 4.5, the most severe injured areas were ankle and neck. In the studies in soccer, and volleyball, it is wildly accepted that

the severe injured areas were at ankle (18,26,46,47). Soccer and volleyball had activities such as jumping and landing like Sepaktakraw. Therefore, it is possible that the most severe injury area was at ankle. False landing after sunback on the neck produced the highest severe injury in an athlete. Because many activities in Sepaktakraw had landing from high jumping, it is possible that severe injuries were produced at areas involved in landing. Therefore, ankle and neck injuries should be aware during playing Sepaktakraw. The preventive strategies to reduce the severity of the injuries at ankle and neck should be included in training and competition. This is because there was higher time loss in ankle and neck more than other areas.

However, the majority of severe injuries were produced during other activities not in Sepaktakraw activities as showed in tables 4.6 and 4.8. Other activities during training such as running follows the ball, jumping and curve running were not in game practice or competition. Those activities were during warm-up, gentle activities to rise body temperature, Sepaktakraw's technique training and cool down. Therefore, the athletes could stop their activities from injuries. During the game, even athletes had injuries, they chose to continue playing. This is because they did not want to stop playing in the middle of the game. Therefore, the number of discontinue and resting before continue were smaller than the number of continue.

5.6 Area of Injuries

Most activities of Sepaktakraw are limb movements, therefore there were many injuries at lower extremities; ankle, knee, hip and thigh as shown in tables 4.1, 4.9 and figure 4.6. The results of this present study are similar to the result of SAT

study. SAT reports high numbers of lower extremity injuries in Sepaktakraw (6). In addition, many sports such as soccer, gymnastics and volleyball that usually had vigorous limb motion often had common injuries at the lower extremities (10,13,17,20,21,43,44,46).

Knee, ankle, back and shoulder injuries were the first four rank which were found in gymnastics (19,20). Studies of volleyball also demonstrated the highest number at ankle injuries followed by knee and hand (13). In soccer' studies, the number of knee injuries was the highest followed by the ankle, thigh and back (10,17,33). The results of those studies showed agreement with the results of the present study. The numbers of injuries in the above studies usually were at lower extremities, which was similar to the present study. The activities of those sports were usually jumping, twisting, rotation and fluttering that similar to the activities in Sepaktakraw. The injuries at lower extremities in sports often occurred during those activities. Knee injuries often produced by twisting or rotation with weight bearing during landing (20). The frequent high jumping produced impacted forces usually increased injuries at ankle (13,20). This present study demonstrated number of ankle injuries produced during landing and tripping as showed in tables 4.14 and 4.15 and figures 4.12 and 4.14. There were also many knee injuries that occurred when landing after jumping, knee fluttering and rotation activities. Therefore, injuries at lower extremities were especially, knee and ankle usually found in Sepaktakraw.

Figure 4.6 shows that the majority of injuries in servers was at hip, groin, foot, toes and bigtoes, whereas great number of injuries in attackers were at ankle, leg,

knee, shoulder and neck. Frequency of injuries in feeders was distributed among many areas, but did not show the high number. From figure 4.11 and tables 4.9, 4.13 that demonstrated high number of hip and groin injuries occurred during swinging leg of serving in servers. During servings, servers had high velocity of swinging and twisting of the whole lower extremities and the other leg was a pivot movement at foot and toes. Therefore, this is the reason why all injuries at toes and foot were in servers. Whereas many hip and groin injuries were during serving, all of shoulder, coccyx, upper back and medial thigh injuries occurred in attackers. This is because the attackers had very aggressive activities. Table 4.15 and figures 4.13-4.16 show 12 acute injuries during attacking in 4 attackers. Landing after attacking produced the majority of shoulder and neck injuries and all coccyx and upper back injuries. Jumping usually produced high impacted forces that often produced ankle injuries (13,20). In addition, landing after jumping could produce knee injuries. High frequency of high jumping in the attackers produced the extreme number of ankle and knee injuries. This is because specific activities usually produced specific area of injuries.

5.7 Type of Injuries

The result of this present study showed that the activities of Sepaktakraw usually produced muscles and tendon injuries. There were many strain injuries in several areas as showed in table 4.10. Spasm and soreness also usually occurred at lower extremities. This is because activities of Sepaktakraw mostly used lower extremities and those activities were produced by muscle action. Therefore, many muscle and tendon injuries often occurred at lower extremities. Not only muscle and tendon of lower extremities were damaged by activities of Sepaktakraw, joint

structures of lower extremities were also destroyed by those activities. All sprains occurred at lower extremities. The highest number of sprain was at ankle followed by knee.

The muscle and tendon injuries were the common injuries in this present study. This result was similar with the results in soccer, volleyball and gymnastics injury studies that the muscle and tendon injuries were commonly found (18-21,46,47). Activities of those sports were like Sepaktakraw activities that needed vigorous and forceful muscle contraction. In addition, there were many studies that supported the efficacy of warm-up to reduce muscle and tendon injuries (41,42,48,49). This present study also demonstrated the efficacy of warm-up and injuries in muscle and tendon. There were effects of warm-up during short period of time. Stewart and Sleivert in 1998 (41) and Whelan et al in 1999 (42) demonstrated that rising of HR and core temperature used to assume muscular temperature. The athletes would have fatigue after that time. That fatigue of over training would leads the athletes risk to injury.

From figure 4.7 shows the majority of injuries in attackers was strain followed by spasm and sprain. Many injuries in servers also strain, whereas injuries in feeders usually were strain and sprain. Muscle and tendon injuries in attackers usually occurred during attacking as shown in table 4.11. Twisting, fluttering, swinging and overload eccentric contraction during attacking were the mechanism to produce muscle and tendon injuries in attackers as shown in table 4.15 and figures 4.13-4.16. Moreover, landing after attacking which produced high impacted forces to the landing

on area also produced strain during attacking. Whereas strains in attackers were produced during attacking, strains in servers usually were produced during serving. Swinging, twisting during serving produced strain in servers. Muscle and tendon injuries in servers were also produced by muscle elongation and over load eccentric contraction. Therefore, the activities that produced strain in attackers and servers were different.

From figure 4.8, majority of injuries which made athletes discontinue sessions were strain, although there was large number of strain which made athlete continue sessions. There were different levels of severity of strain. Strain could produce mild to severe injuries. This is because activities that produced strain were ranked as mild to strenuous activities. Therefore, all strain and consequence of strain should be aware and included in strategies of prevention.

5.8 Mechanism of Injuries

The activities of Sepaktakraw could produce acute injuries as well as overuse injuries. There were 62.27% acute injuries and 37.73% overuse injuries in this present study. The result of present study was in accordance with the result of studies in volleyball (13,47). The results of volleyball study also found acute injuries and overuse injuries, which were similar to this Sepaktakraw study.

Many studies found acute injuries were common in contacted sports (14,24,38,45,46). These injuries were usually produced during aggressively contacted by player or sport instruments, while activities of Sepaktakraw did not. However, the

acute injuries of Sepaktakraw would be from aggressively activities such as fluttering, vaulting, twisting, landing and swinging as shown in figures 4.13-4.17. These Sepaktakraw activities produced majority of acute injuries in this present study. Moreover, activities in this study were repetitive during study period of 3 months. Athletes had to train practice 6 hours a day and 6 days a week, which was very long period. In addition, athletes usually performed similar activities repetitively. Therefore, the overuse injuries would be easily induced.

There were some injuries that produced by activities of the position in team. This is because the athletes of each position usually had specific activities. Activities in servers and feeders were not quite aggressive when compare with attackers. Those activities (serving and feeding) did not usually produce acute injuries. From tables 4.12 and 4.18, acute injuries in attackers occurred during attacking and blocking and acute injuries in servers usually occurred during serving, whereas feeders had acute injuries during feeding and attacking. There were few injuries from switching activities which athletes had no skill. There were 2 injuries in feeders who did summersault and 1 injury in server who did sunback. Although the 3 positions of players can be switched during the game, this alteration could increase number of injuries in athletes who switched the position.

From figures 4.9 and 4.10 show the majority of overuse injuries which had previous symptom at the time of injuries were reported. Those previous symptoms might produce from mild injuries. The athletes judged to ignore them and continued

their activities, until those symptoms were developed to be overuse injuries. Therefore, these injuries were detected.

5.8.1 Acute injuries

From figures 4.11-4.17, acute injuries in Sepaktakraw were not produced from contact forces, but those injuries were from forces generated by personal actions. There were many acute injuries during landing, twisting, vaulting, fluttering of Sepaktakraw activities as in volleyball and gymnastics (13,18-21,47). These aggressive activities produced more forces in compression, tension and torsion. Landing was the majority cause of acute injuries in Sepaktakraw as in volleyball and gymnastics. Landing usually produced strains, sprain, contusion and spasm at neck, shoulder, thigh, knee, ankle and coccyx in this present study. Landing on one leg usually produced acute injuries. In addition, landing on upper extremities showed many injuries as impingement, strain of shoulder. False landing of sunback produced the highest severity, although the sunback seem to be the less aggressive attacking than other attacking activities (table 4.15, figure 4.16).

Landing also produced major problem at structures of landing in volleyball and gymnastics. In gymnastics study that found false landing from tumbling from dismount was the majority of event that produced injuries (19-21). Kind of landing usually produced injuries at ankle and knee. There was also suggestion in landing in gymnastics. Slightly flexed of knees when landing to reduce impacted forces. In Sepaktakraw, there is no scientific evidence about landing. From researcher's observation, there were different kinds of landing after attacking. There

were full knee extensions, slightly knee flexion and forward body roll (especially after full circular summersault). There might be the relationship between kinds of landing and injuries. It is interesting to analyze this relation in further studies.

Swinging and fluttering usually produced spasms, strains and sprain. Twisting produced strains and sprain. The attackers had to jump and flutter or twist roll to produce high speed ball and landing with heavily weight, that would make injuries at muscles or joint structures of ankle, shoulder, knee and leg (table 4.15 and figure 4.13-4.17). These activities usually produced muscle and tendon injuries.

5.8.1.1 Acute injuries during serving

From table 4.13 and figure 4.11, acute injuries during serving were not severe, although the dorsum-foot serving produced the aggressive ball. Serving produced strain, spasm and sprain on parts of swinging leg; groin and hip. This is because activity produced elongation of muscle in these areas.

5.8.1.2 Acute injuries during feeding

From table 4.14 and figure 4.12, acute injuries during feeding were also not severe. The false activities produced injury. During following the ball to feed, the feeders usually watched the ball but could not see the surrounding. One injury, therefore, occurred when tripping with ankle eversion during following the ball.

5.8.1.3 Acute injuries during attacking

Majority of acute injuries was produced during attacking. One of 14 injuries during attacking was the most severe injury. Attacking produced strain, sprain and spasm. From table 4.15 and figures 4.13-16 showed many injuries occurred during full circular summersault, because the athletes usually used full-circular summersault to produce aggressive ball rather than other attacking. Moreover, this attacking was the very aggressive activities. The athlete had to run and jump to produce taking off, then, the aggressive summersault was produced after that. Therefore this present study found many injuries during full circular summersault of attacking. In sunback, the most severe injury was produced. This is because the neck which was miscommunication between attacker and feeder. The feeder produced setting ball which close the net and not high enough for summersault. The attacker who prepared himself for summersault have to suddenly change to sun-back. When the athlete sunback with short ball, the standing foot was old not firmly touch the floor while the attacking leg was fluttering aggressively. Therefore, the standing leg was slide. The injured athlete was vaulting. He was landing on head, neck and upper-back with compact forces from whole body weight. After that, he had dizziness and had to be on supine in position after landing for 15 minutes before he could move and transferred to hospital.

5.8.1.4 Acute injuries during blocking

Blocking also produced injuries during landing. Strain and sprain were usually produced during blocking (figure 4.17, table 4.16). From researcher's observation, most of athletes who had injuries usually landed on one leg

with full extension of weight bearing knee. This is possible that full extension during weight bearing may possible for strain and sprain in blocking. That mechanism demonstrated the activities of Sepaktakraw could produce injury.

5.8.1.5 Acute injuries during other activities

Although the majority of acute injuries occurred during Sepaktakraw activities, 5 severe injuries had produced during other activities such as keeping the ball in warm-up period and curve running. This means the other activities during training camp would also produce injuries in these athletes. Moreover, those injuries produced large time loss than general injuries from Sepaktakraw activities. Therefore, it should be aware that injuries could also happen in additional training.

5.8.2 Overuse injuries

High repetitive activities of these athletes could produce overuse injuries. The athletes had to train 6 hours per day and approximately 6 days per week, which was hard training. Soreness and spasm were found as the majority of overuse injuries. Two soreness after longest game of competition were also produced in server. Because of he was the winner and had many people gave appreciation to him. He did not have any time to stretching. In the day after, he felt pain at both hips.

CHAPTER VI

CONCLUSION

The incidence rate of Sepaktakraw players was 13.58 injuries per 1,000 player-hours in this study. Majority of injuries was found during training more than during competition, although the incidence during training was less than competition. Injuries in attackers were found to be higher than in servers and feeders. There were 25 of 53 injuries that had previous symptoms. Generally, injuries in this study did not disturb athletes' activities more than 1 week. The most severe injury in this present study produced time lost of 18 player-hour in an attacker. Forty of 53 injuries did not produce time loss from participation. Majority of injuries was found at lower extremities; ankle, knee, thigh and hip. Muscle and tendon usually were commonly found in Sepaktakraw injuries. Strain, sprain, spasm were the majority of type of injuries in this study. Sepaktakraw activities could produce acute injuries as well as overuse injuries. There were 33 acute injuries and 20 overuse injuries. The largest number of acute injuries was occurred during attacking followed by other activities, serving, blocking and feeding. Full circular summersault produced the majority of injuries during attacking whereas false landing after sunback produced the most severe injury in this study. Majority of Sepaktakraw overuse injuries had previous symptoms during present injuries. Due to the limitation of subject number, it was unlikely to determine the correlation between risk factors and incidence. However, from the observation, there are some possible factors that might induce injuries, those are

1. Previous symptoms from incomplete healing and lack of education in injury management of athletes

2. Aggressive activities especially full circular summersault

3. High frequency similar to activities in heavy training and consecutive competition

4. Alteration of position in team

This study was the first study, which was a survey report. For further study, it is interesting to analyze the effect of previous injuries, protective devices, duration of training and competition and alteration of position in team to injuries in this athlete group. Moreover, intervention to reduce number and severity of injuries in these athletes should be promoted.

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APPENDIX A

QUESTIONNAIRE INJURY STATUS

(in Thai)

Filled by athletes

<u>แบบสอบถามเรื่อง การบาดเจ็บของนักกีฬาเซปักตะกร้อทีมชาติ</u>

แบบสอบถามฉบับนี้เป็นส่วนหนึ่งในวิทยานิพนธ์เรื่อง การบาดเจ็บในนักกีฬาเซปักตะกร้อทีมชาติประเภทชาย ซึ่งการสำรวจนี้มีวัตถุประสงค์เพื่อศึกษาระบาดวิทยาของการบาดเจ็บในนักกีฬาเซปักตะกร้อทีมชาติ และข้อมูลดังกล่าวมีเป้าหมายในการนำไปใช้ป้องกันการเกิดการบาดเจ็บในนักกีฬาเซปักตะกร้อทีมชาติ

เพื่อให้ข้อมูลจากการศึกษานี้เกิดประโยชน์ตามวัตถุประสงค์ ขอให้ท่านตอบแบบสอบถามในทุกข้อตามความเป็นจริง ผู้ศึกษาขอขอบพระคุณในความร่วมมือเป็นอย่างยิ่ง

<u>แบบสอบถามเรื่อง การบาดเจ็บของนักกีฬาเซปักตะกร้อ</u>

วันที่_____

ชื่อ-สกุล_____ตำแหน่งผู้เล่น_____

วันเดือนปีเกิด _____ประสบการณ์เล่นตะกร้อ เป็นเวลา_____ปี

1. ขณะนี้มีการบาดเจ็บหรือไม่

   ☐ มี ☐ ไม่มี

หากขณะนี้มีการบาดเจ็บให้กรอกในข้อที่ 2 ต่อไป หากไม่มีกรุณาลงชื่อผู้กรอกในส่วยท้ายของแบบสอบถาม

2. *<u>ถ้ามี</u>* โปรดระบายตำแหน่งที่บาดเจ็บ หากมีมากกว่า 1 ตำแหน่งโปรดลำดับความรุนแรง โดยตำแหน่งที่รุนแรงที่สุดเป็นตำแหน่งที่ 1

3. **การบาดเจ็บดังกล่าวเกินในช่วงใด**

ตำแหน่งที่ 1 เกิดขณะ ☐ ซ้อม ☐ แข่ง เมื่อ_____ ขณะทำท่า _____
(ว/ด/ป โดยประมาณ)

ตำแหน่งที่ 2 เกิดขณะ ☐ ซ้อม ☐ แข่ง เมื่อ_____ ขณะทำท่า _____
(ว/ด/ป โดยประมาณ)

ตำแหน่งที่ 3 เกิดขณะ ☐ ซ้อม ☐ แข่ง เมื่อ _____ ขณะทำท่า _____
(ว/ด/ป โดยประมาณ)

4. **ต้องหยุดการแข่งขันหรือการซ้อมหรือไม่**

ตำแหน่งที่ 1 ☐ ไม่หยุด ☐ หยุด เป็นเวลา _____
ตำแหน่งที่ 2 ☐ ไม่หยุด ☐ หยุด เป็นเวลา _____
ตำแหน่งที่ 3 ☐ ไม่หยุด ☐ หยุด เป็นเวลา _____

5. **การบาดเจ็บดังกล่าวได้รับการรักษาหรือไม่**

ตำแหน่งที่ 1 ☐ รักษา ☐ ไม่ได้รักษา
ตำแหน่งที่ 2 ☐ รักษา ☐ ไม่ได้รักษา
ตำแหน่งที่ 3 ☐ รักษา ☐ ไม่ได้รักษา

6. **รายละเอียดการรักษาดังกล่าว**

6.1 ทานยาหรือไม่

ตำแหน่งที่ 1 ☐ ไม่ทาน ☐ ทาน โปรดระบุชื่อยา _____
ตำแหน่งที่ 2 ☐ ไม่ทาน ☐ ทาน โปรดระบุชื่อยา _____
ตำแหน่งที่ 3 ☐ ไม่ทาน ☐ ทาน โปรดระบุชื่อยา _____

6.2 ได้ทำการรักษาโดย

ตำแหน่งที่ 1 ☐ นักกายภาพบำบัด ☐ แพทย์ ☐ โค้ชหรือคนในทีม
☐ ตนเอง ☐ อื่นๆ _____
ตำแหน่งที่ 2 ☐ นักกายภาพบำบัด ☐ แพทย์ ☐ โค้ชหรือคนในทีม
☐ ตนเอง ☐ อื่นๆ _____
ตำแหน่งที่ 3 ☐ นักกายภาพบำบัด ☐ แพทย์ ☐ โค้ชหรือคนในทีม
☐ ตนเอง ☐ อื่นๆ _____

7. **ขณะนี้มีระดับอาการเป็นเช่นไร**

ตำแหน่งที่ 1 ☐ ดีขึ้น_____% ☐ เท่าเดิม ☐ แย่ลง _____%

ตำแหน่งที่ 2 ☐ ดีขึ้น_____% ☐ เท่าเดิม ☐ แย่ลง _____%

ตำแหน่งที่ 3 ☐ ดีขึ้น_____% ☐ เท่าเดิม ☐ แย่ลง _____%

ลงชื่อ _____

ผู้กรอก

APPENDIX B

PERSONAL INFORMATION

(in Thai and English)

Filled by researcher

แบบบันทึกข้อมูลส่วนบุคคลของนักกีฬา

วันที่ _____

1.ชื่อ-สกุล _____ **2.ประสบการณ์การเล่นตะกร้อ** _____ **ปี**

3.ตำแหน่ง ☐ หลังเสิร์ฟ ☐ หน้าซ้ายขว/ทำ ☐ หน้าขวาขว/ทำ

4.อายุ _____ ปี

5.น้ำหนัก_____ kg **ส่วนสูง**_____ ซม.

6.Body type ☐ hyposthenic built ☐ sthenic built ☐ hyperstenic built

7.โรคประจำตัวและการรักษา _____

_____

8.อุปกรณ์ประจำตัว

☐ สนับเข่า/knee support/knee brace ☐ ซ้าย ☐ ขวา

☐ รองเท้าหุ้มข้อ (high-top shoes) ☐ **รองเท้าไม่หุ้มข้อ** (low-top shoes)

☐ ankle support ☐ ซ้าย ☐ ขวา

☐ อื่นๆ _____

9.ความถนัด ☐ ขวา ☐ ซ้าย

10.gross flexibility

10.1.มือแตะปลายเท้าขณะนั่ง long sitting : ☐ แตะ ☐ ไม่แตะ **ระยะห่าง**_____ ซม.

-มีตึงหรือเจ็บหรือไม่ ☐ ไม่มี ☐ มี

บริเวณ ☐ upper back ☐ lower back ☐ hamstring

☐ gastro-soleous ☐ lateral part of thigh

☐ อื่นๆ_____

10.2.มือแตะปลายเท้าขณะยืนเข่าชิดและเหยียด : ☐ แตะ ☐ ไม่แตะ **ระยะห่าง**_____ ซม.

-มีตึงหรือเจ็บหรือไม่ ☐ ไม่มี ☐ มี

บริเวณ ☐ upper back ☐ lower back ☐ hamstring

☐ gastro-soleous ☐ lateral part of thigh

☐ อื่นๆ_____

10.3.knee to chest : มีตึงหรือไม่ ☐ ไม่มี ☐ มี

บริเวณ ☐ lower back ☐ upper back ☐ middle back

☐ อื่นๆ_____

11.Neurology test

มีชาบริเวณไหนหรือไม่ ☐ ไม่มี ☐ มี

บริเวณ _____

12.PROM

activity	range		Activity	range	
	Rt.	Lt.		Rt.	Lt.
Neck :			**shoulder (cont.):**		
Flexion			hori.abd.		
Extension			hori.add.		
Rotation to Lt.			**Elbow :**		
Rotation to Rt.			Flexion		
lat. flex to Lt.			Extension		
lat. flex to Rt.			**Hip :**		
Trunk :			Flexion		
Flexion			Extension		
Extension			IR		
Rotation to Lt.			ER		
Rotation to Rt.			Abduction		
Shoulder :			Adduction		
Flexion			**Knee :**		
Extension			Flexion		
IR			Extension		
ER			**Ankle :**		
Elevation			Dorsiflexion		
Depression			Plantarflexion		
Abduction			Eversion		
Adduction			Inversion		

NOTE : _____

13.Upper extremity alignment

13.1shoulder ☐ normal ☐ abnormal _____

13.2elbow ☐ normal ☐ abnormal _____

13.3wrist ☐ normal ☐ abnormal _____

14.Lower extremity alignment

14.1hip ☐ normal ☐ abnormal _____

14.2knee ☐ normal ☐ abnormal _____

14.3ankle ☐ normal ☐ abnormal _____

15.Spine alignment in standing

15.1 cervicle ☐ normal ☐ abnormal _____

15.2 thorasic ☐ normal ☐ abnormal _____

15.3 lumbar ☐ normal ☐ abnormal _____

16.Posture in standing _____

_____

17.Other deformity _____

_____

18.Other complaint/Note _____

_____

APPENDIX C

GENERAL DATA OF SESSION

(in Thai and English)

Filled by researcher

แบบบันทึกข้อมูลการซ้อม/การแข่งประจำวัน

วันที่ _____ ☐ **ซ้อม** ☐ **แข่ง** **สถานที่** _____ **ผู้กรอก** _____

เวลา _____ : **เฉพาะแข่ง** ก. Tournament _____ **ข.รอบ** _____

ผู้ขาดซ้อม 1. _____ เนื่องจาก _____

(หากซ้อม) 2. _____ เนื่องจาก _____

3. _____ เนื่องจาก _____

4. _____ เนื่องจาก _____

ผู้เข้าแข่งขัน 1. _____ 2. _____

(หากแข่ง) 3. _____ 4. _____

ผู้ได้รับบาดเจ็บขณะซ้อม/แข่ง

1. _____ อาการ/วินิจฉัย _____ การปฐมพยาบาล _____

2. _____ อาการ/วินิจฉัย _____ การปฐมพยาบาล _____

3. _____ อาการ/วินิจฉัย _____ การปฐมพยาบาล _____

สภาพอากาศ

- ☐ ร้อน ☐ กำลังดี ☐ หนาว ☐ อบอ้าว
- ☐ ฝนตก ☐ ฝนไม่ตก

Equipment

-พื้น ☐ ชำรุด ☐ ไม่ชำรุด

-ตาข่าย ☐ ชำรุด ☐ ไม่ชำรุด

-ลูกตะกร้อ ☐ ชำรุด ☐ ไม่ชำรุด

Programe training

-warm up _____

-training ☐ weigth training ☐ aerobic training ☐ technique

☐ อื่นๆ โดย _____

-cool down _____

ข้อสังเกตุเพิ่มเติม/ข้อสรุป _____

_____

APPENDIX D

INJURY FORM

(in Thai)

Filled by researcher

แบบบันทึกการบาดเจ็บในนักกีฬาตะกร้อ

1.ชื่อ _____ **วันที่ได้รับบาดเจ็บ** _____

2.chieft complaint

_____

3.ตำแหน่งผู้เล่น ☐ หลังเสิร์ฟ ☐ หน้าซ้ายทำ/ชง ☐ หน้าขวาทำ/ชง

4.Area

	☐ head/neck	☐ back low/mid/upper	☐ trunk	
☐ *Rt.*	☐ shoulder	☐ arm	☐ elbow	☐ forearm
	☐ wrist	☐ hand	☐ fingers	ระบุ _____
☐ *Lt.*	☐ hip	☐ groin	☐ thigh post./ant./lat./med.	
	☐ knee	☐ leg	☐ ankle	
	☐ foot	☐ toes	ระบุ _____	

5.เกิดการบาดเจ็บขณะ a. ☐ ซ้อม ☐ แข่ง ☐ อื่น ๆ ระบุ _____

b. ☐ warm-up ☐ stretching ☐ technique/game ☐ cool-down

6.Injury mechanism ☐ *acute onset* ☐ *gradual onset*

☐ **เสิร์ฟ** *หลังเท้า/ข้างเท้า*	☐ ขาหลัก ☐ ขาเหวี่ยง ☐ มือ-เหวี่ยง ☐ อื่นๆ ระบุ	☐ พื้นก่อนโดนลูก ☐ อากาศ-ก่อนโดนลูก ☐ อากาศ-ขณะโดนลูก ☐ อากาศ-หลังโดนลูก ☐ พื้น-หลังโดนลูก	☐ ระบุไม่ได้ note _____
☐ **ชง/ตามลูก** *แปร/หลังเท้า หน้าขา/สั้น*	☐ ขาหลัก ☐ ขาชง	☐ พื้น-ก่อนโดนลูก ☐ อากาศ-ก่อนโดนลูก ☐ อากาศ-ขณะโดนลูก ☐ อากาศ-หลังโดนลูก ☐ พื้น-หลังโดนลูก	☐ ระบุไม่ได้ note _____

☐ ทำ ☐ ขาหลัก ☐ *กระโดดม้วนตัวกลางอากาศ* ☐ ช่วงแรกของการกระโดดมีอย่างน้อย 1 ขา อยู่บนพื้น

☐ ขาฟาด ☐ *กระโดดหันข้างลอยตัวต่ำเตะ* ☐ อากาศ-ก่อนโดนลูก

☐ มือเหวี่ยง/ลงพื้น ☐ *กระโดดเตะสลับขา* ☐ อากาศ-ขณะโดนลูก

☐ *กระโดดเหยียบ/ยืนเหยียบ* ☐ อากาศ-หลังโดนลูก

☐ *กระโดดเขกด้วยศีรษะ* ☐ ลงสู่พื้น 1 ขา/2 ขา/2 มือ

☐ *กระโดดตบด้วยฝ่าเท้า หรือลูกปาด* ☐ ระบุไม่ได้ note _____

☐ บล็อก ☐ *หันข้างยกลำตัวและขา* ☐ ขา/ลำตัวด้านเดียวกับเน็ต

☐ *หันหลัง/ใช้แผ่นหลังบล็อก* ☐ ขา/ลำตัวด้านตรงข้ามเน็ต

☐ *อื่นๆ* _____ ☐ มือปิดศีรษะ

☐ มือไม่ปิดศีรษะ

☐ ช่วงแรกของการกระโดด มีอย่างน้อย 1 ขาอยู่บนพื้น

☐ อากาศ-ก่อนโดนลูก

☐ อากาศ-ขณะโดนลูก

☐ อากาศ-หลังโดนลูก

☐ ลงสู่พื้น 1 ขา/ 2 ขา/ 2 มือ

☐ ระบุไม่ได้ note _____

☐ โยน ☐ ก่อนปล่อยลูก ☐ ขณะปล่อยลูก ☐ หลังปล่อยลูก ☐ ระบุไม่ได้ note _____

☐ **overuse/repetitive syndrome/ อื่นๆ** ระบุ _____

☐ **ระบุไม่ได้**

7.Previous injury ☐ ไม่มี ☐ มี

in same area *ถ้ามี* -เมื่อ _____

-อาการก่อนการบาดเจ็บใหม่ ☐ หาย ☐ ไม่หายเป็นตลอดเวลา

☐ เป็นๆหายๆ ระบุ _____

-mechanism _____

8.Immediate action

☐ เล่นต่อทันที ☐ หยุดนาน _____ และเล่นต่อได้ใน game/practice นั้นๆ

☐ หยุดและไม่สามารถเล่นต่อได้ใน game/practice นั้นๆ

9.อุปกรณ์ที่ใส่ขณะเกิดการบาดเจ็บ

☐ knee support/สนับเข่า ☐ ankle support

☐ strap/tape/elastic bandage ☐ ผ้าโพกศีรษะ

☐ high/low-top shoes ☐ อื่นๆ ระบุ _____

10.Type of injury

-skin : abrasion/blister/bruises/incision/laceration/avulsion/puncture/ อื่นๆ _____

-musculotendinous : contusion/strain/tendinitis/tenosynovitis/myositis/fasciitis/myositis ossificans/calcific tendinitis/bersitis/cramp/soreness/spasm/อื่นๆ _____

-joint and structure : sprain/subluxation/dislocation/synovitis/capsulitis/อื่นๆ _____

-articular surface injuries : ostiochondral defects/OA/อื่นๆ _____

-bony injury : exostosis/apophysis/fracture/avulsion fracture/stress fracture/อื่นๆ _____

-neurovascular pathologies : peripheral nerve injury/RSD/อื่นๆ _____

-อื่นๆ : osteositis (etc. Shin splint)/อื่นๆ _____

11.Initial treatment

☐ ice/cyropratic ☑ levation ☐ pressure/compression ☐ ไม่มี

☐ heat ☐ taping/straping/elastic bandage ☐ อื่นๆ _____

12.Date of examination _____ **by** _____

13.Diagnosis _____

14.Plan management _____

APPENDIX E

CHARACTERISTICS OF ATHLETES

Table E.1 Demographic of athletes

Athlete no.	Age	Height (cm.)	Weight (kg.)	Position in team	Dominant site
1	27	168	55	server	right
2	34	174	63	feeder	left
3	27	171	61	server	left
4	28	177	72	attacker	right
5	26	175	68	attacker	right
6	32	180	64	attacker	right
7	26	175	64	attacker	right
8	29	160	54	feeder	right
9	21	184	70	server	right
10	24	176	65	feeder	right
11	28	173	65	attacker	left
12	25	171	65	server	right

Table E.2 Personal Equipment

Athlete no.	Knee support	Shoes	Ankle support	Other
1	-	High top	Lt./Rt.	-
2	Lt./Rt.	Low top	Lt./Rt.	-
3	-	High top	Lt./Rt.	-
4	Lt.	Low top	Rt.	Sport tape at wrist
5	Lt.	Low top	-	Spot tape at wrist
6	Rt.	Low top	Lt./Rt.	-
7	Lt./Rt.	Low top	-	Tobi grip at leg
8	-	High top	Lt./Rt.	-
9	Lt./Rt.	High top	Lt./Rt.	-
10	Lt./Rt.	High top	Lt./Rt.	-
11	Lt.	Low top	-	-
12	-	High top	Lt./Rt.	-

Table E.3 Gross flexibility of athletes

Athlete no.	Long sitting and reach to toe (area of tension during done)	Standing and reach to toe (area of tension during done)	Knee to chest (area of tension during done)
1	Y	Y	Y
2	Y(lower back)	Y(lower back)	Y(lower back)
3	Y	Y	Y
4	Y(hamstring)	Y	Y
5	Y	Y	Y
6	Y	Y	Y
7	Y	Y	Y
8	Y	Y	Y
9	Y(hamstring)	Y(hamstring)	Y
10	Y	Y	Y
11	Y	Y	Y
12	Y	Y	Y

Y = athlete can do whole process

TableE.4 Visible malalignment areas and other notice during Function Test

Athlete no.	Flat foot	Scoliosis	Low back	Middle back	Upper back
1	-	Y	Hpl	-	-
2	-	-	Hpl, Hpm	-	-
3	-	-	Hpl, Hpm	Flat	-
4	-	-	-	-	Flat
5	-	Y	Hpl	Flat	-
6	-	Y	Hpl	-	-
7	-	-	Hpl	Flat	Flat
8	-	-	-	-	-
9	-	-	Pain	-	-
10	-	Y	-	-	-
11	Y	Y	Hpl	-	-
12	Y	Y	-	Flat	-

Y = have sign
Hpl = hypolordotic
Hpm = hypomobile

Table E.5 Abnormal symptoms at the first day of study

Athlete no.	Symptoms	Area	Duration of symptoms	Status
1	N	-	-	-
2	Y	Low back	*	70%<
3	N	-	-	-
4	Y	Rt. wrist	*	++
5	Y	Rt. wrist	11 months	70%<
6	Y	Rt. knee	*	80%<
7	N	-	-	-
8	N	-	-	-
9	Y	Lt. hip, Lt. knee, Lt. foot, Rt. hip	All over 6 months	90%<
10	N	-	-	-
11	N	-	-	-
12	N	-	-	-

Y = have symptoms
N = not have symptoms
++ = symptoms are decreasing
* = not specify
XX%< = the percentage of the decreasing of symptoms

Table E.6 Details of injuries in each athlete.

Athlete no.	Position in team	Total injuries	Area of injury	Mechanism of injury		Severity of injury	Type of injuries
				Acute	Overuse		
1	server	2	groin	serving	-	continue	spasm
			bigtoe	-	overuse	continue	blister
2	feeder	6	ear	other	-	rest before continue	laceration
			low back	-	overuse	continue	spasm
			hip	attacking	-	continue	strain
			hip	-	overuse	continue	soreness
			knee	feeding	-	continue	sprain
			knee	-	overuse	continue	sprain
3	server	0	-	-	-	-	-
4	attacker	9	head/neck	attacking	-	discontinue	strain
			head/neck	-	overuse	continue	soreness
			hip	not specified	-	continue	strain
			anterior thigh	blocking	-	continue	strain
			anterior thigh	attacking	-	continue	strain
			anterior thigh	other	-	discontinue	strain
			knee	attacking	-	continue	sprain
			leg	-	overuse	continue	soreness
			ankle	other	-	discontinue	sprain

Table E.6 Details of injuries in each athlete (continued)

Athlete no.	Position in team	Total injuries	Area of injury	Mechanism of injury		Severity of injury	Type of injuries
				Acute	Overuse		
5	attacker	7	head/neck	blocking	-	rest before continue	strain
			shoulder	attacking	-	continue	strain
			shoulder	attacking	-	continue	spasm
			shoulder	attacking	-	continue	strain
			shoulder	-	overuse	continue	strain
			posterior thigh	attacking	-	continue	spasm
			coccyx	attacking	-	rest before continue	strain
6	attacker	4	medial thigh	blocking	-	continue	strain
			posterior thigh	attacking	-	continue	spasm
			knee	blocking	-	continue	sprain
			knee	-	overuse	continue	other
7	attacker	3	leg	-	overuse	continue	spasm
			leg	-	overuse	continue	spasm
			ankle	other	-	rest before continue	sprain
8	feeder	0	-	-	-	-	-

Table E.6 Details of injuries in each athlete (continued)

Athlete no.	Position in team	Total injuries	Area of injury	Mechanism of injury		Severity of injury	Type of injuries
				Acute	Overuse		
9	server	10	head/neck	other	-	discontinue	strain
			hip	serving	-	continue	sprain
			hip	serving	-	continue	strain
			hip	-	overuse	continue	soreness
			hip	-	overuse	continue	soreness
			groin	other	-	discontinue	strain
			posterior thigh	attacking	-	continue	strain
			anterior thigh	serving	-	continue	strain
			ankle	-	overuse	continue	tendinitis
			foot	-	overuse	continue	other
10	feeder	4	anterior thigh	-	overuse	continue	strain
			groin	attacking	-	continue	strain
			ankle	feeding	-	continue	sprain
			ankle	-	overuse	continue	tendinitis
11	attacker	6	upper back	attacking	-	discontinue	strain
			knee	-	overuse	discontinue	spasm
			leg	other	-	discontinue	strain
			ankle	attacking	-	rest before continue	sprain
			ankle	-	overuse	continue	sprain
			ankle	-	overuse	continue	tendinitis
12	server	2	toe	-	overuse	continue	blister
			knee	other	-	rest before continue	other

BIOGRAPHY

NAME	Miss Karuna Neraphong
DATE OF BIRTH	8 March 1976
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Srinakarinvirot University, 1993 – 1996 Bachelor of Science (Physiotherapy) Mahidol University, 1997-2000 Master of Science (Physiotherapy)