



Descriptive analysis of selected alignment factors of the lower extremity in relation to lower extremity trauma in athletic training
by Janice Marie Lillevedt

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Physical Education
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Abstract:

A study was conducted to investigate the relationships between lower extremity alignments and the shin splint syndrome in female athletes. Selected measures describing the alignment of the lower extremities of thirty-two women athletes were taken. Data recorded were classified into: Group 1 - a no shin splint group; Group 2 - a current moderate shin splint group; Group 3 - a current severe shin splint group; Group 4 - a previous shin splint group; and Group 5 - a current shin splint group. Data were analyzed through the use of an analysis of variance, a Duncan's test, and a step-wise regression.

The analysis of variance found that there were significant alignment differences ($p < .05$) between subjects who had no shin splints, subjects who had shin splints previously, and subjects who currently had shin splints.

The Duncan's test indicated the variables which were significantly different ($p < .05$) between each of the above mentioned groups. Ten of the fifteen measures varied significantly between the no shin splint group and the current shin splint group and between the no shin splint group and the previous shin splint group. Eleven of the fifteen measures varied significantly between the previous shin splint group and the current shin splint group.

The step-wise regression indicated that six of the fifteen measures taken could be used to predict the occurrence of the shin splint syndrome. The six predictive factors included: the degree of external rotation of the femur with the hip extended, the degree of dorsiflexion of the ankle with the knee both flexed and extended, the degree of inversion at the subtalar joint, the frontal plane position of the tibia/subtalar joint static, and the position of the calcaneus in relationship to the floor/subtalar joint static.

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DESCRIPTIVE ANALYSIS OF SELECTED ALIGNMENT FACTORS
OF THE LOWER EXTREMITY IN RELATION TO LOWER
EXTREMITY TRAUMA IN ATHLETIC TRAINING

by

JANICE MARIE LILLETVEDT

A thesis submitted in partial fulfillment of
the requirements for the degree

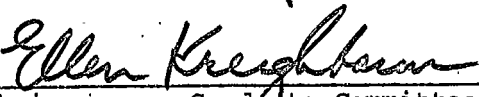
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ABSTRACT

A study was conducted to investigate the relationships between lower extremity alignments and the shin splint syndrome in female athletes. Selected measures describing the alignment of the lower extremities of thirty-two women athletes were taken. Data recorded were classified into: Group 1 - a no shin splint group; Group 2 - a current moderate shin splint group; Group 3 - a current severe shin splint group; Group 4 - a previous shin splint group; and Group 5 - a current shin splint group. Data were analyzed through the use of an analysis of variance, a Duncan's test, and a step-wise regression.

The analysis of variance found that there were significant alignment differences ($p < .05$) between subjects who had no shin splints, subjects who had shin splints previously, and subjects who currently had shin splints.

The Duncan's test indicated the variables which were significantly different ($p < .05$) between each of the above mentioned groups. Ten of the fifteen measures varied significantly between the no shin splint group and the current shin splint group and between the no shin splint group and the previous shin splint group. Eleven of the fifteen measures varied significantly between the previous shin splint group and the current shin splint group.

The step-wise regression indicated that six of the fifteen measures taken could be used to predict the occurrence of the shin splint syndrome. The six predictive factors included: the degree of external rotation of the femur with the hip extended, the degree of dorsiflexion of the ankle with the knee both flexed and extended, the degree of inversion at the subtalar joint, the frontal plane position of the tibia/subtalar joint static, and the position of the calcaneus in relationship to the floor/subtalar joint static.

Chapter 1

INTRODUCTION

Shin splints have directly afflicted athletes and hence have been a concern of coaches, trainers, and doctors for many years. Consequently, much attention has been given to the shin splint syndrome. The occurrence of the syndrome is erratic, i.e., it may only affect one of two athletes even though both are of similar condition and follow equally stressful training programs. Likewise, the treatment of the shin splint syndrome is erratic, and what alleviates the pain for one individual may have no effect upon another person's pain even though both persons are diagnosed as having the same ailment.

Recently, some podiatrists and medical doctors have proposed that orthotics, or shoe inlays, be used to treat the shin splint syndrome (12). This proposal is based on the hypothesis that the alignment of the lower extremity and/or a lack of flexibility of the hamstring muscle group may be the causative agents of the syndrome. Although, to the author's knowledge, there has been no research that supports this hypothesis, such treatments, i.e., use of orthotics, have been used (22:111). In one case a male high school basketball player was enabled, through the use of orthotics, to play an entire basketball game. Without the use of the shoe inlays, the athlete was limited to less than one full quarter of play by the syndrome (12).

The following study was done in an attempt to discover whether or not certain alignments of the lower leg and/or the flexibility of certain muscle groups are related to the occurrence of shin splints. Determining whether or not these relationships are significant would lend support or opposition to the treatment of shin splints through the method of realigning the lower extremity.

Statement of the Problem

The general purposes of this investigation were to determine whether or not specific populations could be described according to selected lower extremity measures and to determine the relative importance of the selected measures of the lower extremity to the relative severity of the shin splint syndrome, and which of these measures, if any, could best be used to predict the occurrence of the syndrome.

Specifically, the investigator attempted:

1. to determine whether the alignment of the lower extremity, as defined by fifteen selected measures, varied between persons who never had shin splints, persons who had shin splints previously, and persons who currently had shin splints.
2. to determine which of the selected measures, if any, varied significantly between the three groups described.

3. to determine which of the selected measures, if any, could best be used to predict the occurrence of the shin splint syndrome.

Selected measures used included the ranges of inversion and eversion of the subtalar joint, dorsiflexion of the ankle with the knee both flexed and extended, external and internal rotation of the femur with the hip both flexed and extended, flexibility of the hamstring muscle group, and the positions of the forefoot in relationship to the rearfoot with the subtalar joint neutral, frontal plane of the tibia with the subtalar joint in static stance and neutral position, calcaneus in relationship to the floor with the subtalar joint in static stance and neutral position, and the malleoli with the subtalar joint in static stance position.

Hypotheses

Null Hypotheses. It was hypothesized that there would be no significant difference in the lower extremity alignment as described by the selected measures between persons who never had shin splints, persons who had shin splints previously, and persons who currently had shin splints, i.e., these specific populations could not be independently described according to the alignment of the lower extremity. Furthermore, it was hypothesized that there would be no significant correlation between the occurrence or non-occurrence of the shin splint syndrome and any of the measures used to describe the lower extremity

alignment, i.e., none of the measures used to describe lower extremity alignment could be used to predict the occurrence of the shin splint syndrome.

Alternate. It was hypothesized that there would be a significant difference in the alignment of the lower extremity, as described by the fifteen measures, between persons who never had shin splints, persons who had shin splints previously, and persons who currently had shin splints, i.e., these three specific populations could be independently described according to the alignment of their lower extremities. In addition, it was hypothesized that there would be a significant correlation between each of the selected measures and the occurrence or non-occurrence of the shin splint syndrome. Hence, it would be possible to predict the occurrence of the shin splint syndrome using the fifteen measures.

The hypotheses would be individually accepted at the .05 level of significance.

Definition of Terms

The following terms, unless otherwise noted, were used in the study as they were defined by Root (15).

Abduction. Abduction is any action in which the distal aspect of the foot, or a part of the foot, moves away from the body's midline.

Axis of rotation is in the frontal and sagittal planes and motion occurs in a transverse plane.

Adduction. Adduction is any action in which the distal aspect of the foot, or a part of the foot, moves toward the body's midline. Axis of rotation is in the frontal and sagittal planes and motion occurs in a transverse plane.

Dorsiflexion. Dorsiflexion is any action in which the distal aspect of the foot, or a part of the foot, moves toward the tibia. Rotation is around the frontal and transverse axis and motion occurs in a sagittal plane.

Eversion. Eversion is any action in which the distal aspect of the foot, or a part of the foot, tilts away from the body's midline. Axis of rotation is in the sagittal and transverse planes and the motion occurs in the frontal plane.

Inversion. Inversion is any action in which the distal aspect of the foot, or a part of the foot, tilts toward the body's midline. Axis of rotation is in the sagittal and transverse planes and motion occurs in the frontal plane.

Neutral position of the subtalar joint. The neutral position of the subtalar joint is that point at which the foot is neither

pronated nor supinated. From this position, the calcaneus will invert twice as many degrees as it will evert.

Plantarflexion. Plantarflexion is any action in which the distal aspect of the foot, or a part of the foot, moves away from the tibia. Rotation is around the frontal and transverse axis and motion occurs in the sagittal plane.

Pronation. Pronation is simultaneous action of the foot in the directions of abduction, eversion, and dorsiflexion. Axis of rotation runs from the posterior lateral and plantar surface of the foot to the anterior, medial, and dorsal surface, and allows motion in three planes simultaneously.

Shin splints. Shin splints is the condition diagnosed by the symptoms of tenderness to the touch and pain in the lower leg along the anterior medial side of the tibia with resultant discomfort (5).

Subtalar joint. The subtalar joint is the contact point between the calcaneus and the talus.

Supination. Supination is simultaneous action of the foot in the direction of adduction, inversion, and plantarflexion. Axis of rotation runs from the posterior lateral, and plantar surface of the foot to the anterior, medial, and dorsal surface and allows motion in three planes simultaneously.

Valgus. A valgus position of the foot is an inverted structural position of the foot or a part of the foot.

Varus. A varus position of the foot is an everted structural position of the foot or a part of the foot.

Delimitations

Only those measures previously mentioned were taken for the study. The investigation of the shin splint syndrome dealt with the syndrome as it occurs only on the anterior medial aspect of the tibia in female athletes.

Limitations

Each subject was evaluated at a random time during the day, and evaluations were done during the weeks of April 5-9, and April 12-16, 1976.

No control was placed on the type of shoe the subjects wore during workouts, the type of surface on which the workouts were done, or the type of activity engaged in by the subjects. Also, no attempt was made to measure the amount of physical activity the subjects engaged in daily.

All subjects were active in that each was competing on a varsity level in either track, basketball, volleyball, or gymnastics.

The researcher attempted to eliminate those persons who had suffered or who were currently suffering from sprained ankles, knee injuries, hip problems, and other injuries of the lower extremity. It was felt that such injuries would bias the data collected.

Chapter 2

REVIEW OF RELATED LITERATURE

Definition of Shin Splints

The term shin splint, although commonly used by trainers, physicians, coaches, and athletes, is often used without being specifically defined. In essence, the term shin splint is a "waste basket" term and is used in reference to many different conditions. Considerable argument arises when an attempt to define the term is made. One fact generally agreed upon, however, is that the condition is unique to the lower leg. Conditions frequently referred to as shin splints include:

1. Strains of the tibialis anterior or the tibialis posterior.
2. Tearing of the interosseous membrane between the tibia and the fibula.
3. Irritation of the periosteum due to tendons pulling away from it.
4. Inflammation of the tendons or the dorsiflexors of the foot (28:68-69).

Generally it is agreed that shin splints are an irritation or inflammation of or along the interosseous membrane. The membrane acts as an elastic buffer zone between the fibula and the tibia, helps stabilize the two bones, and serves as an attachment for both anterior and posterior muscle groups. The anterior muscles are the foot

flexors and are responsible for dorsiflexion, raising and lowering the toes, controlling the arch, and inverting the foot, as well as aiding in plantarflexion in an eccentric manner. Posterior muscles are the foot extensors and are responsible for plantarflexion, everting the foot, pronation, and helping to control dorsiflexion in an eccentric manner.

For purposes of the study, shin splints were defined as a condition diagnosed by the symptoms of tenderness to the touch and pain in the lower leg along the anterior-medial aspect of the tibia with resultant discomfort (5). By definition, the shin splint syndrome was limited to the anterior medial side of the tibia. No differentiation was made between persons complaining and being diagnosed as having the syndrome in the distal 1/3 of the lower leg and persons complaining and being diagnosed as having the syndrome in the proximal 1/3 of the leg.

Symptoms of Shin Splints

It is generally accepted that the following symptoms are prime indicators that the condition of shin splints is present.

1. Dull, achy, cramplike pain is felt in the lower leg, along the tibial crest--the shin.
2. Pain will increase with running, and/or dorsiflexion and/or plantarflexion.

3. Pain will subside with rest.
4. The shin is tender to the touch (5).

Biomechanics of Running and Walking

Before considering causative factors or enhancing agents of the shin splint syndrome, the functioning of the lower extremity during running or walking activities should be understood. Shin splints, after all, do occur when the lower extremity is placed in a stressful situation (running, walking, jumping, etc.) and are symptomatically treated by resting the lower extremity.

Walking or running activity of the lower extremity may be broken down into two basic phases--a stance phase and a swing phase. The stance phase is further divided into three stages, these being the contact stage, the mid-stance stage, and the propulsive or toe-off stage. The contact or heel strike stage of stance is the pronatory portion of the gait where the leg and thigh are still internally rotating. Foot-strike may occur with the weight on the ball of the foot, the entire foot, or the heel of the foot depending upon the running techniques, the demands for speed and the type of movement required (17:359). During the mid-stance stage of gait, the subtalar joint should be in neutral position, the mid-tarsal joint should be fully pronated, and the foot should be moving out of pronation and into supination (12). Near the end of the mid-stance stage, the foot acutely dorsiflexes,

thus readying itself for propulsion (17:359). Upon supination, the foot becomes more stable and more powerful. During the propulsive stage of stance, the leg externally rotates, the foot fully supinates, thus becoming the rigid lever needed at toe-off (12). The swing phase of gait sees the leg internally rotating and preparing for heel contact (12).

Many difficulties may be encountered if the proper mechanics of walking and/or running are not observed and most of the difficulties encountered when the proper biomechanics of walking/running are not observed deal with pronation. According to Subotnick (23:15), "a pronated foot at toe-off has a tendency to adversely affect the ankle, knee and/or leg and results in many overuse symptoms."

Anytime the lower extremity and its actions are discussed, the concept of the lower extremity being a linked system must be taken into consideration, since, in a linked system, what occurs in one part of such a system will cause changes in the other parts of that same system. Because the lower extremity is such a system, the effect of the subtalar joint is one of a torque converter, i.e., movement in one direction by the tibia will bring about movement in the opposite direction by the calcaneus due to the action of the subtalar joint (12).

Causes of Shin Splints

The etiology of shin splints is unknown. In attempting to determine the cause of shin splints, many factors must be considered. Speculations advanced as to the cause of shin splints include faulty posture alignment, fallen arches, muscle fatigue, overuse stress, body chemical imbalance, or a lack of proper reciprocal muscle coordination between the anterior and posterior aspects of the leg (6:255).

Running on a hard surface, or switching to a hard surface after running on a soft surface are often spoken of as causative agents of shin splints. Klafs and Arnheim (6) believe that strenuous work on a hard surface will bring about the shin splint syndrome.

Some authors (1:24-25; 16:29-39; 28:68-69) believe that when muscle groups of the lower leg lack strength and/or flexibility, shin splints will result.

More recently, improper foot alignment has been proposed as a cause of shin splints (4:55-60; 14:28-36; 21:1-8; 22:104-113). Cerney (2) believes that whenever the problem of shin splints is considered, the foot must also be considered. He cautions us to, "Remember that as the foundation goes, so goes the building,--and in ALL cases of shin splints a foot problem is present concurrently (2:91). Sheehan (21:6) states that the foot is an architectural marvel, but that improper alignment or balance of its parts may lead to shin splints.

For persons promoting this theory, the concept of structural balance is very important.

Treatments of Shin Splints

The care and prevention of shin splints varies from case to case, and there is much controversy when various types of treatment are discussed. In dealing with shin splints, one actually deals with the symptoms and not the cause since the cause is unknown. Regardless of the type of treatment employed, there is agreement that one can not run shin splints out, and that full recovery from the affliction requires time. Many treatments for shin splints have been proposed and utilized with each claiming some degree of success. Treatments usually include rest, heat, and strapping. Aspirin, friction massage, ice massage, stretching exercises, and felt pads may also be used. Preventive measures usually call for stretching and strengthening of the muscles of the lower leg, and strapping of the longitudinal arch of the foot prior to games and practices (1:24-25; 3:111-139; 6:255-256; 7:73-74; 8:171-173; 10:536-539; 11:42-50; 13:83-90).

Recently the use of orthotics for both prevention and treatment of shin splints has been proposed (2:91-96; 16:29-39; 20:85-89; 24:31-35; 26:75-79). This proposal is based on the premise that if the foot functions within established guidelines, many athletic injuries to the lower extremity can be decreased. Such guidelines

state what range of motion is normal at the various joints in the lower extremity and thus allows for the most efficient functioning of the foot. The following values are accepted as biophysical criteria for normalcy.

1. In the static tibial stance position, the distal 1/3 of the leg is vertical. However, a variance of 2° varum or 2° valgum is acceptable provided the subtalar joint is normal (15:34,131).
2. In a relaxed calcaneal stance position, ideally the subtalar joint rests in its neutral position, i.e., the calcaneus is perpendicular to the ground and parallel to the distal 1/3 of the leg. However, a variance of 2° inversion to 2° eversion of the calcaneus is acceptable in persons age seven years to adult (15:34,131). At the subtalar joint there should be twice as much inversion as there is eversion (12).
3. A line bisecting the posterior surface of the calcaneus will be vertical (15:34,131).
4. The plantar forefoot lies perpendicular to the line bisecting the posterior surface of the calcaneus, i.e., at the midtarsal joint, zero degrees of varus and zero degrees of valgus should be reported (15:34,131; 12).

5. At the ankle joint, a minimum of 10° of dorsiflexion is necessary for normal locomotion (15:34,131).
6. External malleolar torsion of $13-18^{\circ}$ is considered normal for persons age six years to adult (15:130).
7. At the hip joint there should never be more internal rotation than external rotation. Usually there is twice as much external rotation as there is internal rotation, but even a ratio of 1:1 is acceptable (12). The minimum total range of motion necessary for normal locomotion is $15-20^{\circ}$ (15:131).
8. The hamstring muscle group must not be more than 20° flexed from the vertical position when the subject is lying on her back with the hip flexed at 90° (12).

Chapter 3

METHODS AND PROCEDURES

Instrumentation

A manual biometer developed by Phillips (12) was used to collect data for the study (see Figures 1-6).

The biometer consisted of a number of protractor-like devices and was capable of measuring body positions and/or segmental movements in terms of degrees. The instrument could be broken apart so that various protractors within the instrument could be used to take the various measurements. Figure 6, although not truly a part of the biometer, was used to establish the plane position of the forefoot in relationship to the rearfoot and so was required during the examination.

Face validity of the instrument was accepted.

Data Collection Techniques

Pictorial descriptions of the measures taken to describe the alignment of the lower extremity are illustrated in Figures 7-26. A detailed description of the methods used to collect the data may be obtained from the author.

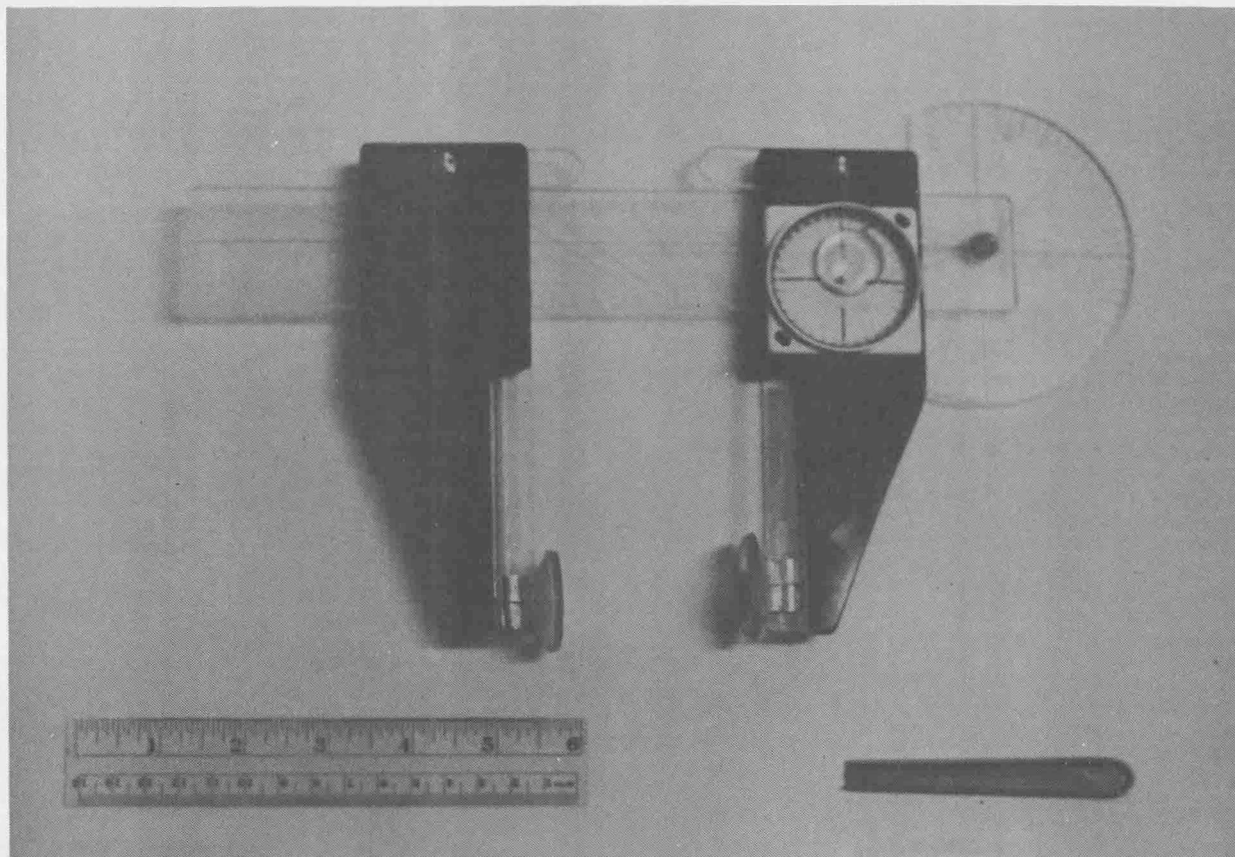


Figure 1. Assembled instrumentation required to conduct a complete biomechanical examination of the lower extremity

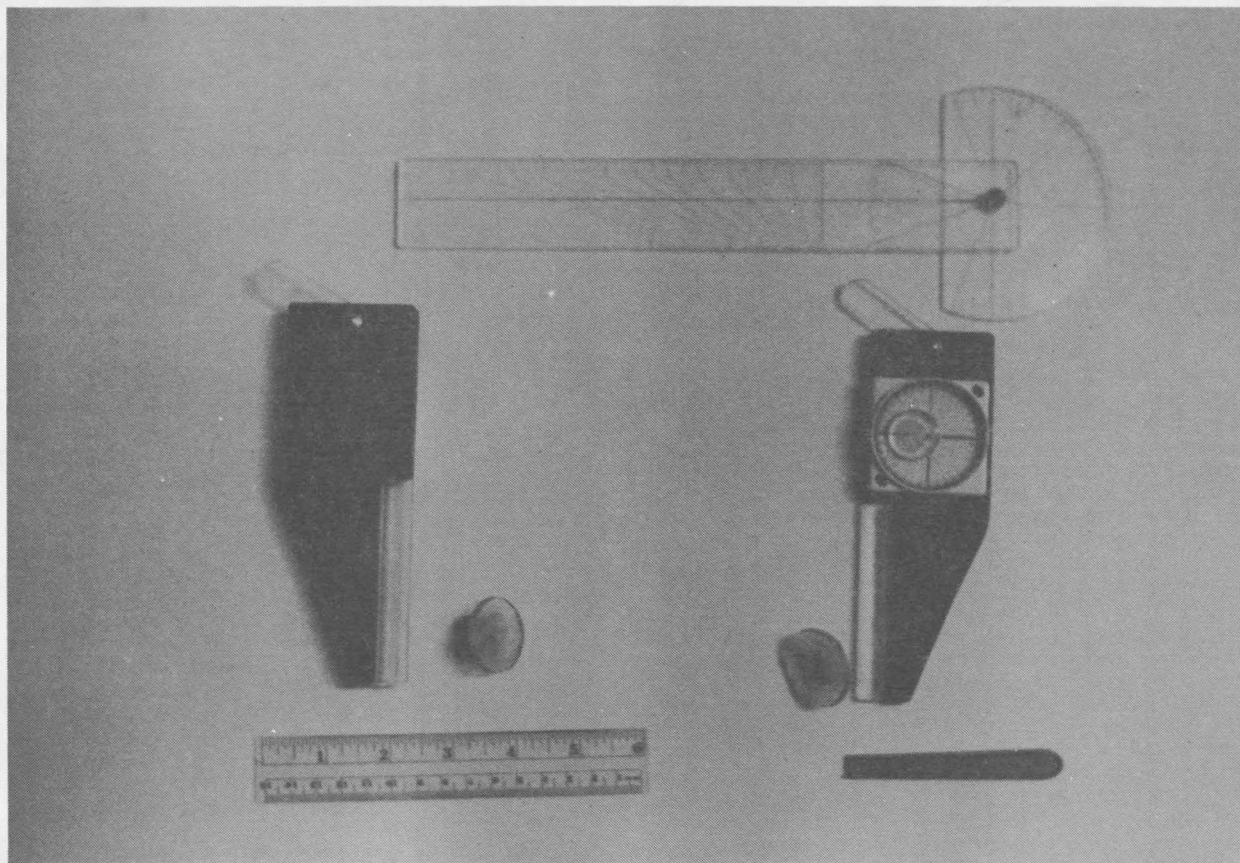


Figure 2. Disassembled instrumentation required to conduct a complete biomechanical examination of the lower extremity

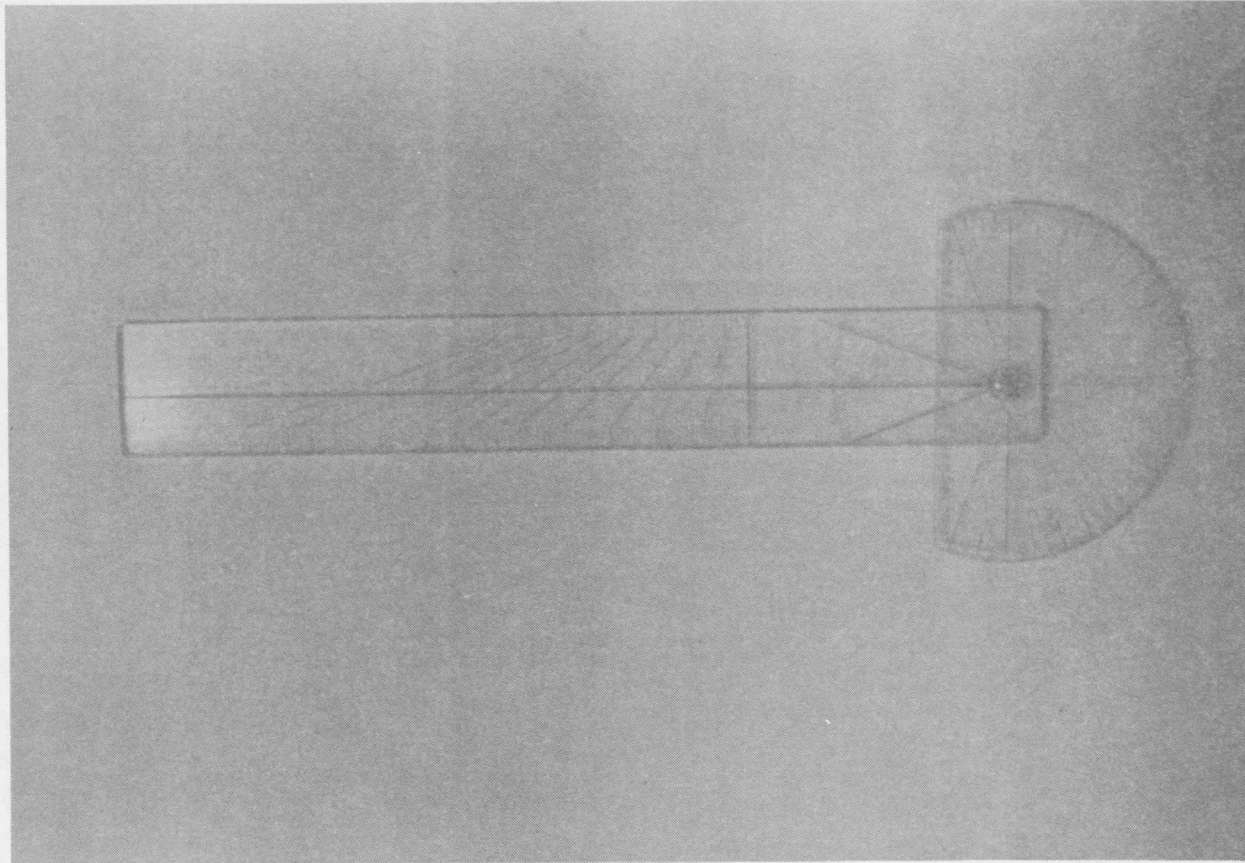


Figure 3. Instrumentation required to measure inversion and eversion of the subtalar joint, and the position of the forefoot in relationship to the rearfoot

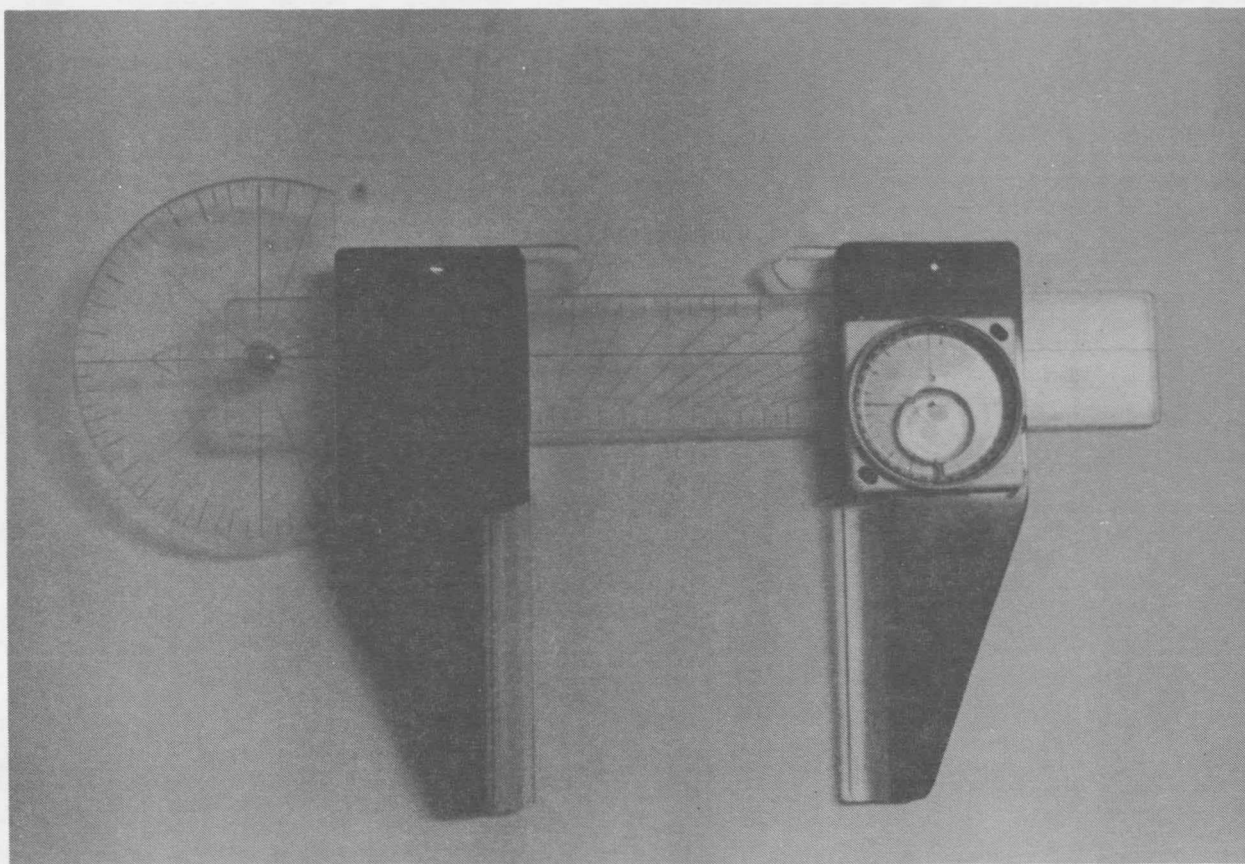


Figure 4. Instrumentation required to bisect the calcaneus and tibia and measure the positions of both the tibia and the calcaneus with the subtalar joint both static and neutral, the flexibility of the hamstring muscle group, and the degree of dorsiflexion of the ankle with the knee both flexed and extended

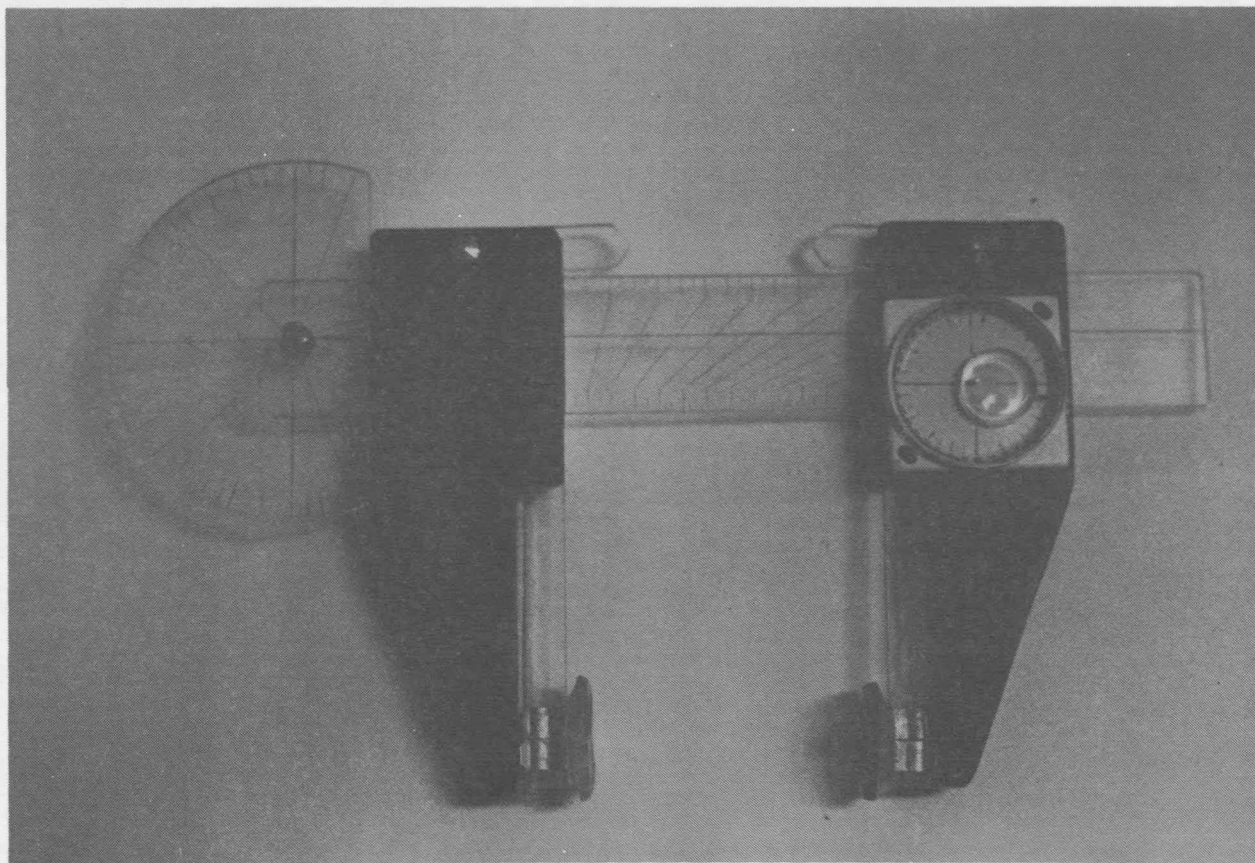


Figure 5. Instrumentation required to measure internal and external rotation of the femur with the hip both flexed and extended, and the position of the malleoli

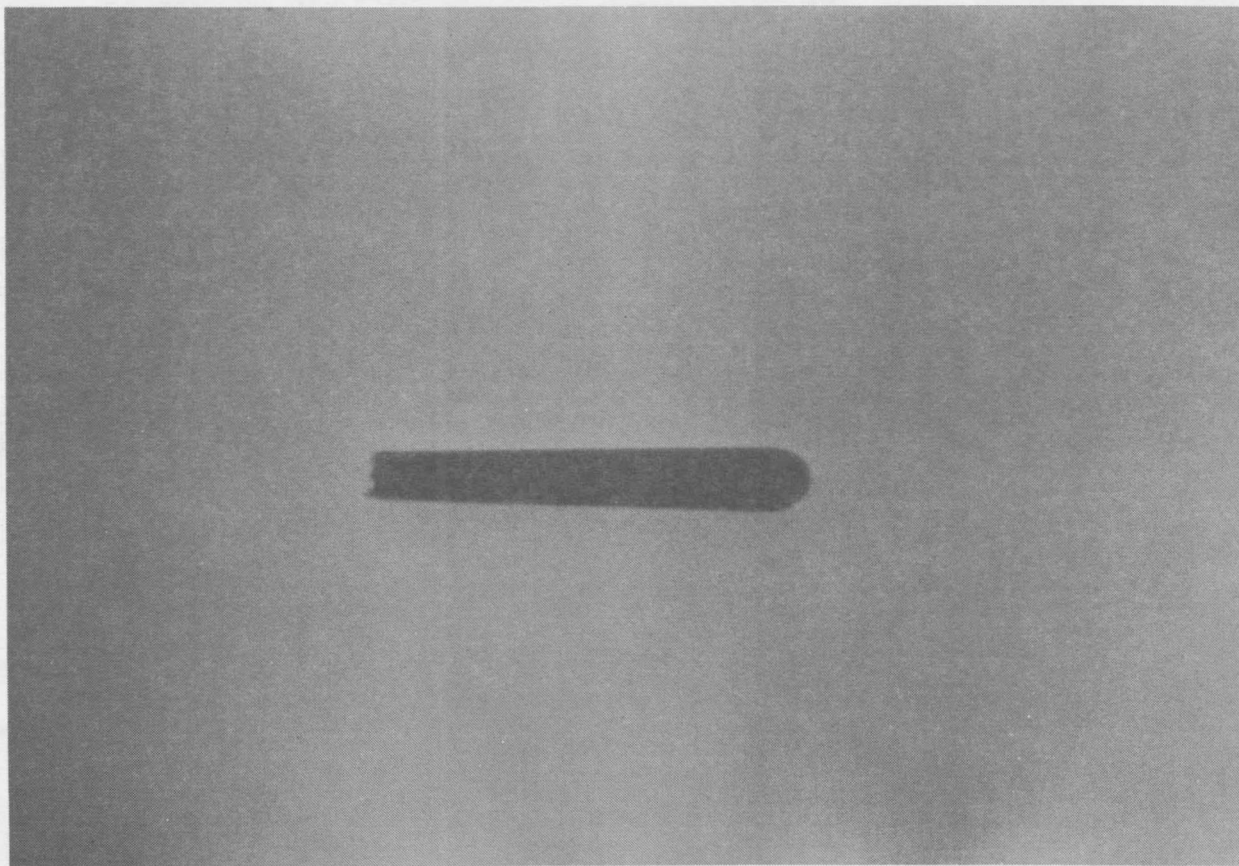


Figure 6. Instrumentation used to determine the plane position of the forefoot

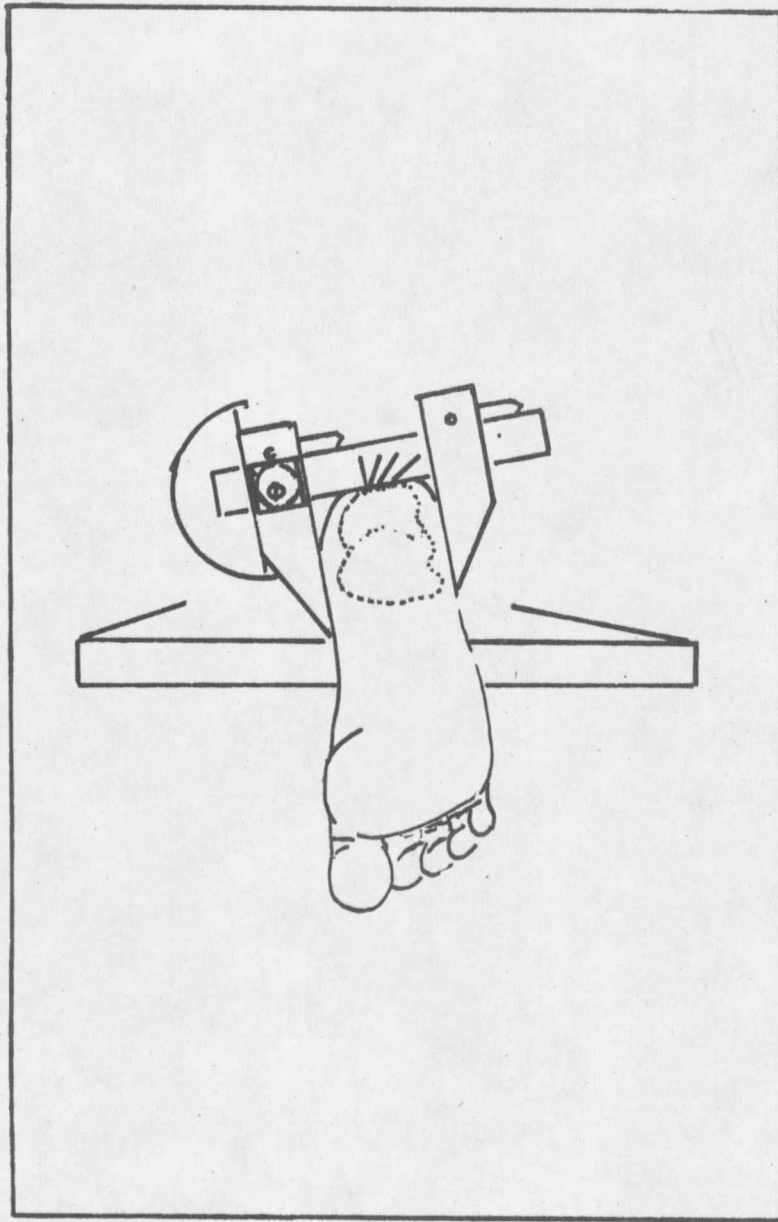


Figure 7. Bisecting the calcaneus

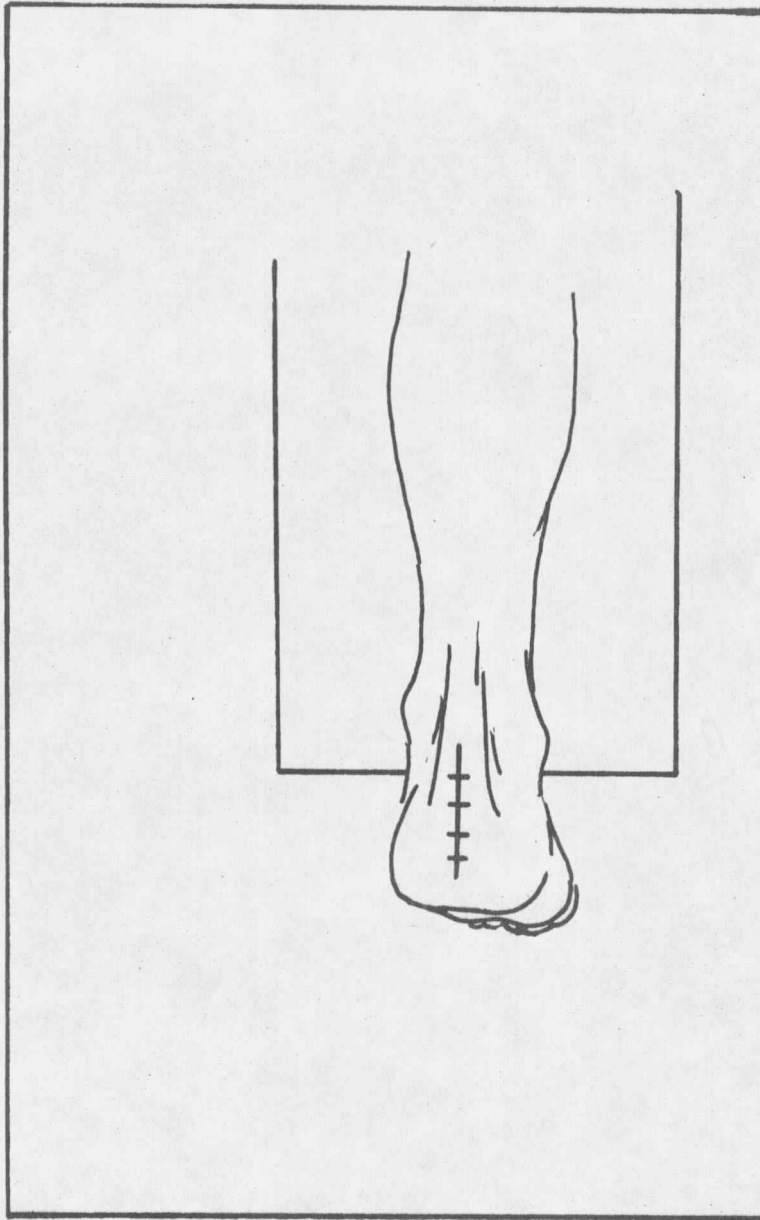


Figure 8. Line bisecting the calcaneus

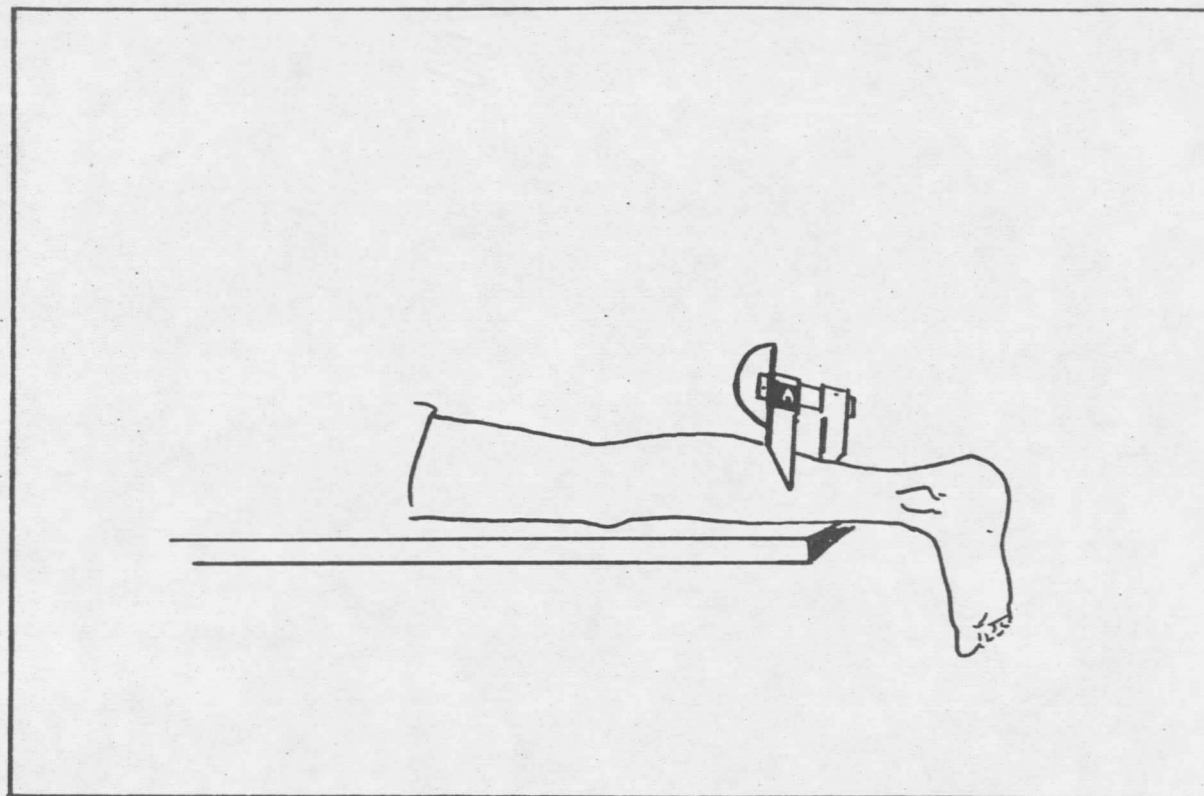


Figure 9. Bisecting the distal 1/3 of the leg

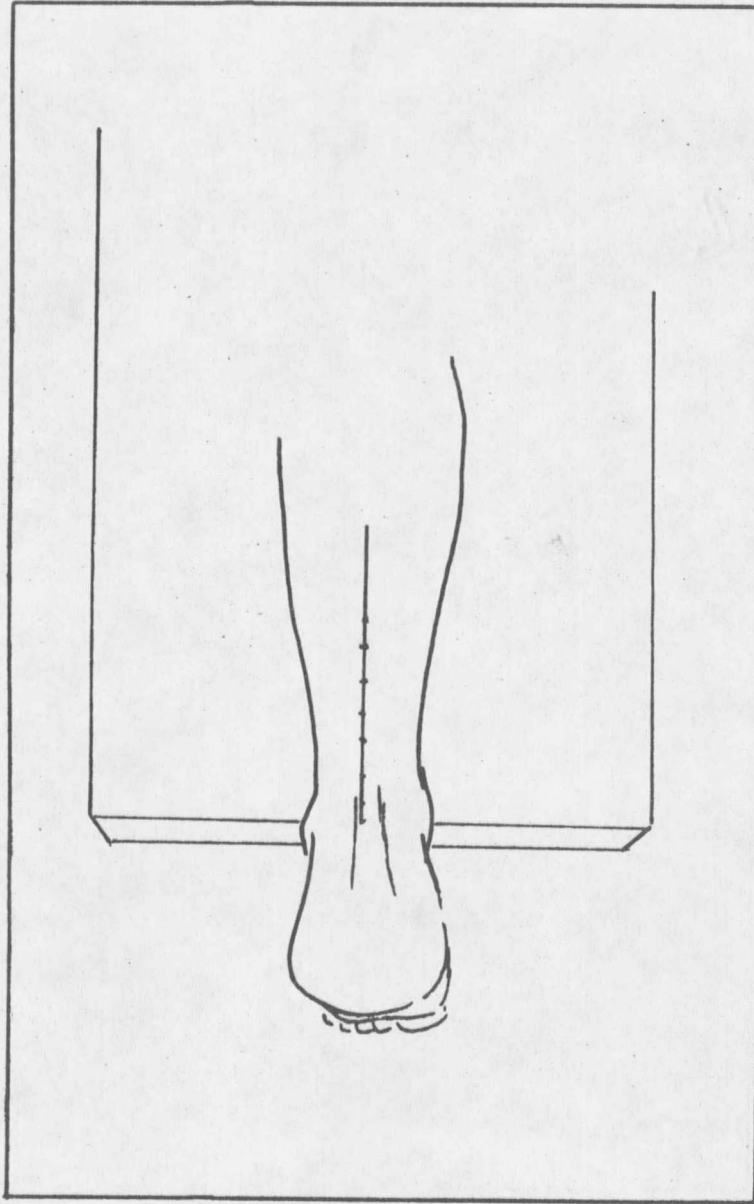


Figure 10. Line bisecting the distal 1/3 of the leg

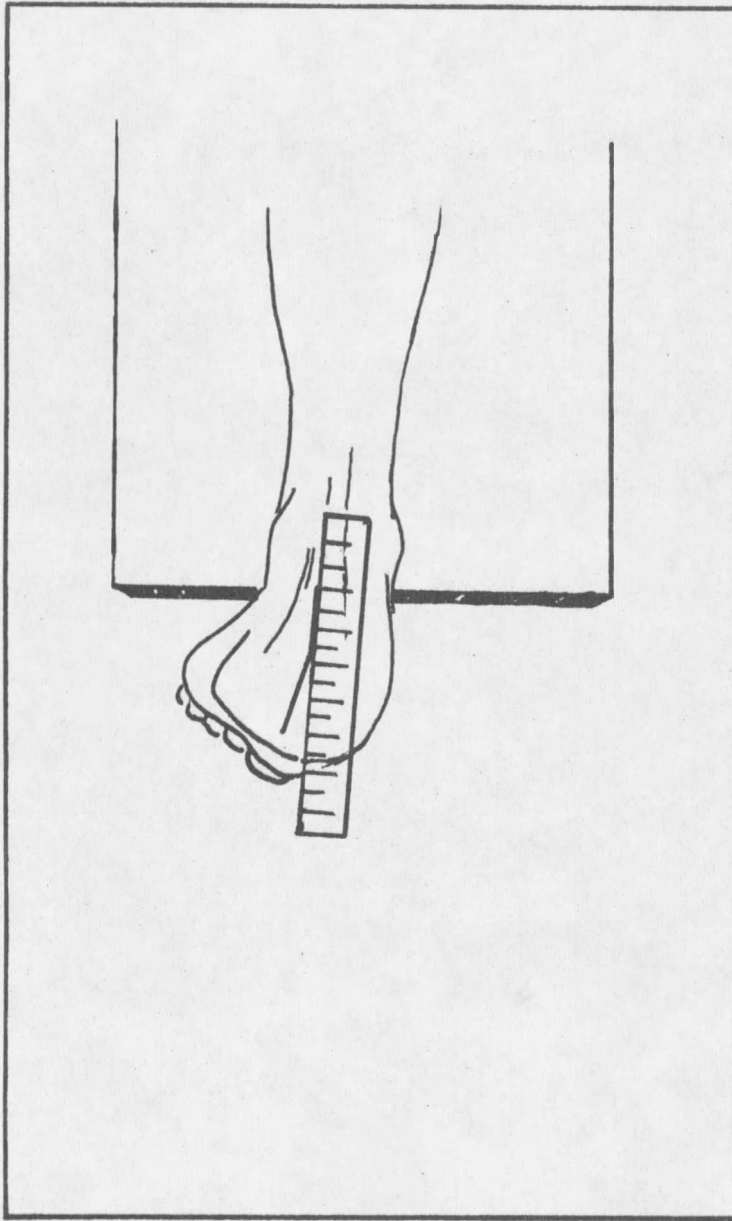


Figure 11. Determining axis of rotation for the subtalar joint (eversion)

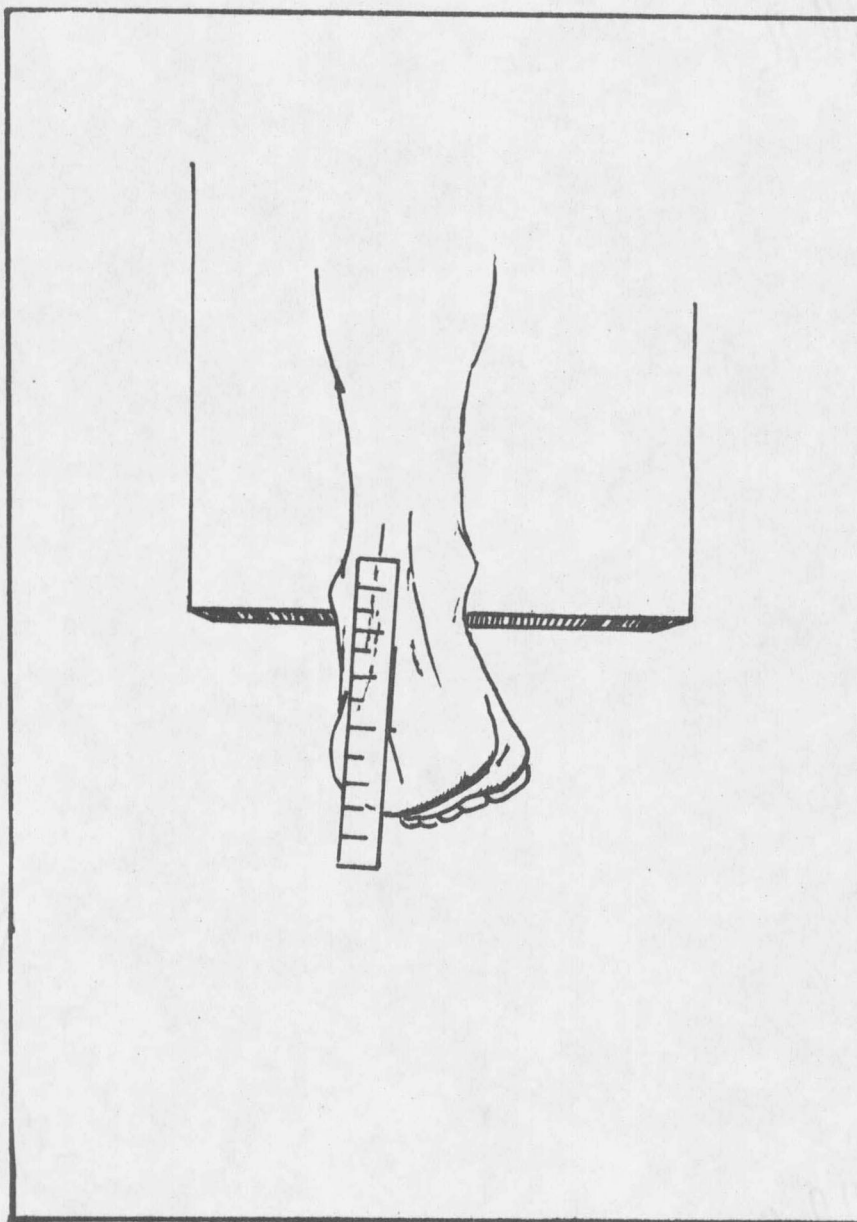


Figure 12. Determining axis of rotation for the subtalar joint (inversion)

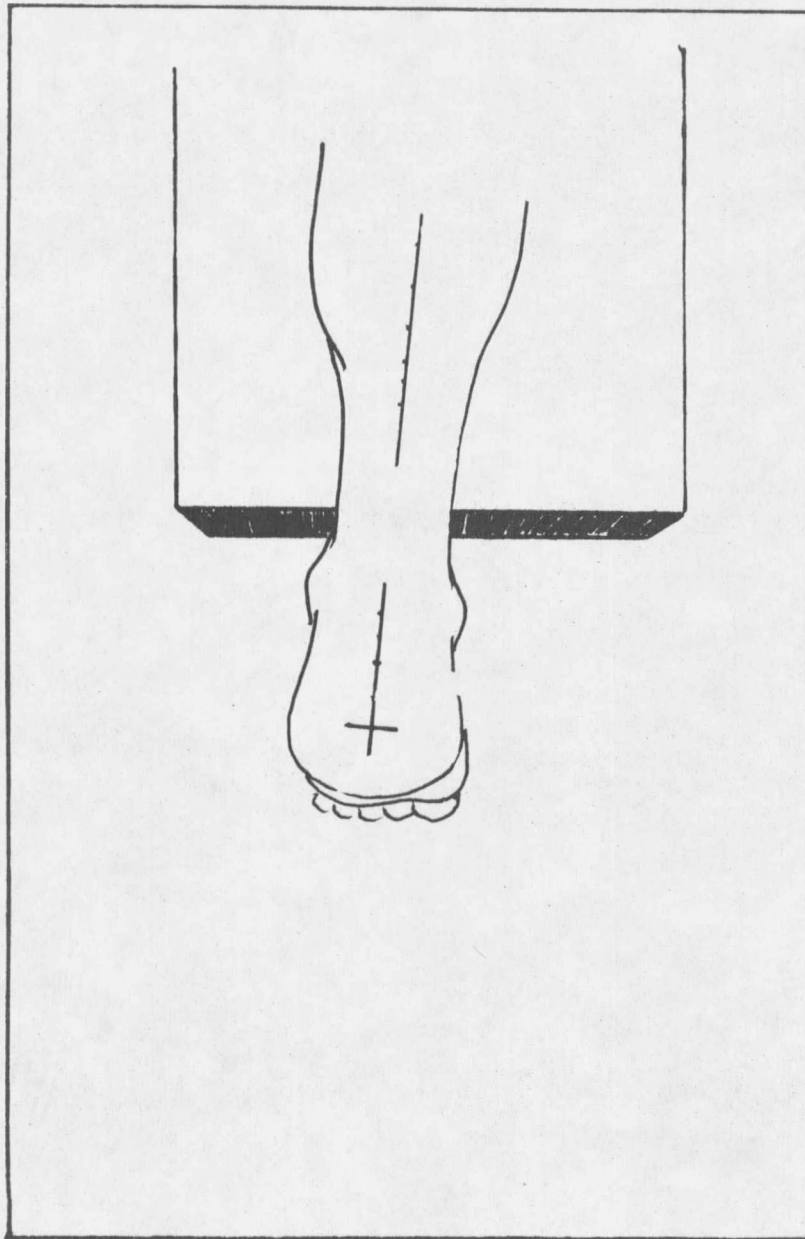


Figure 13. Lines bisecting the calcaneus, the lower leg, and denoting axis of rotation of the subtalar joint

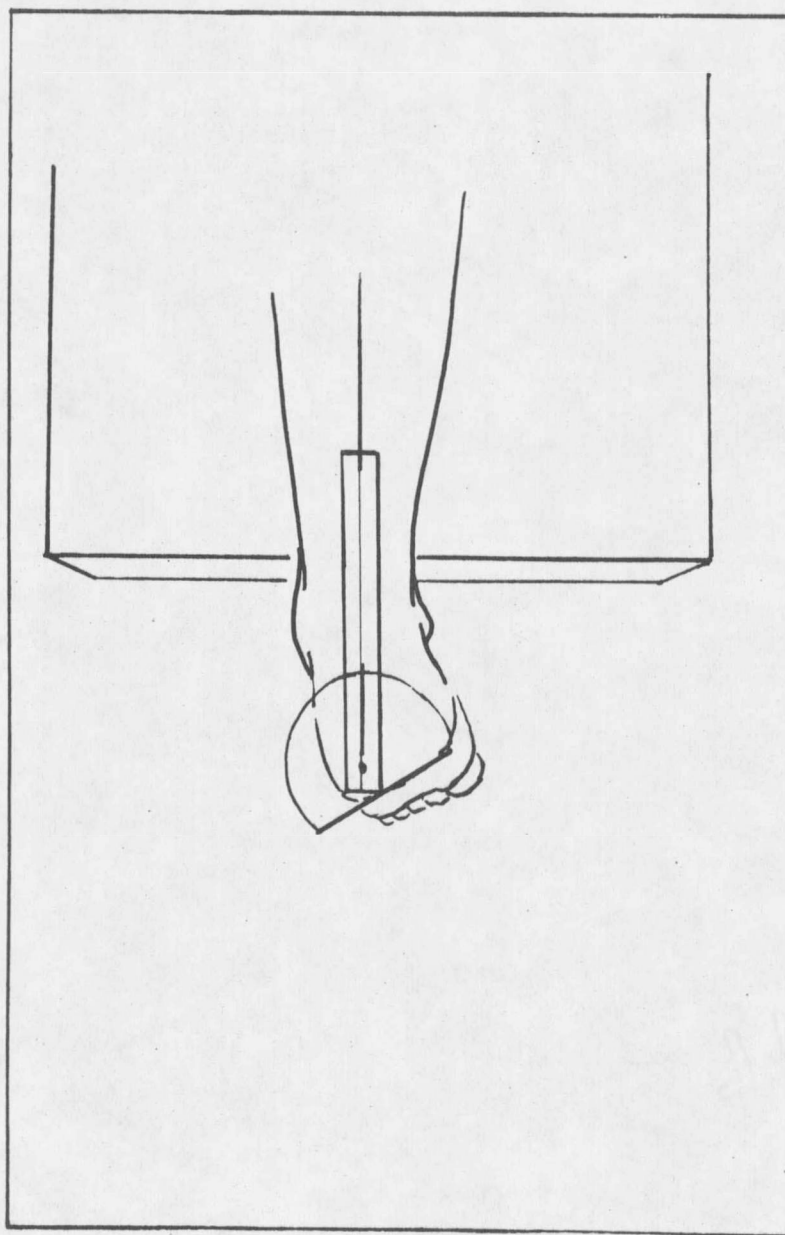


Figure 14. Determining inversion at the subtalar joint

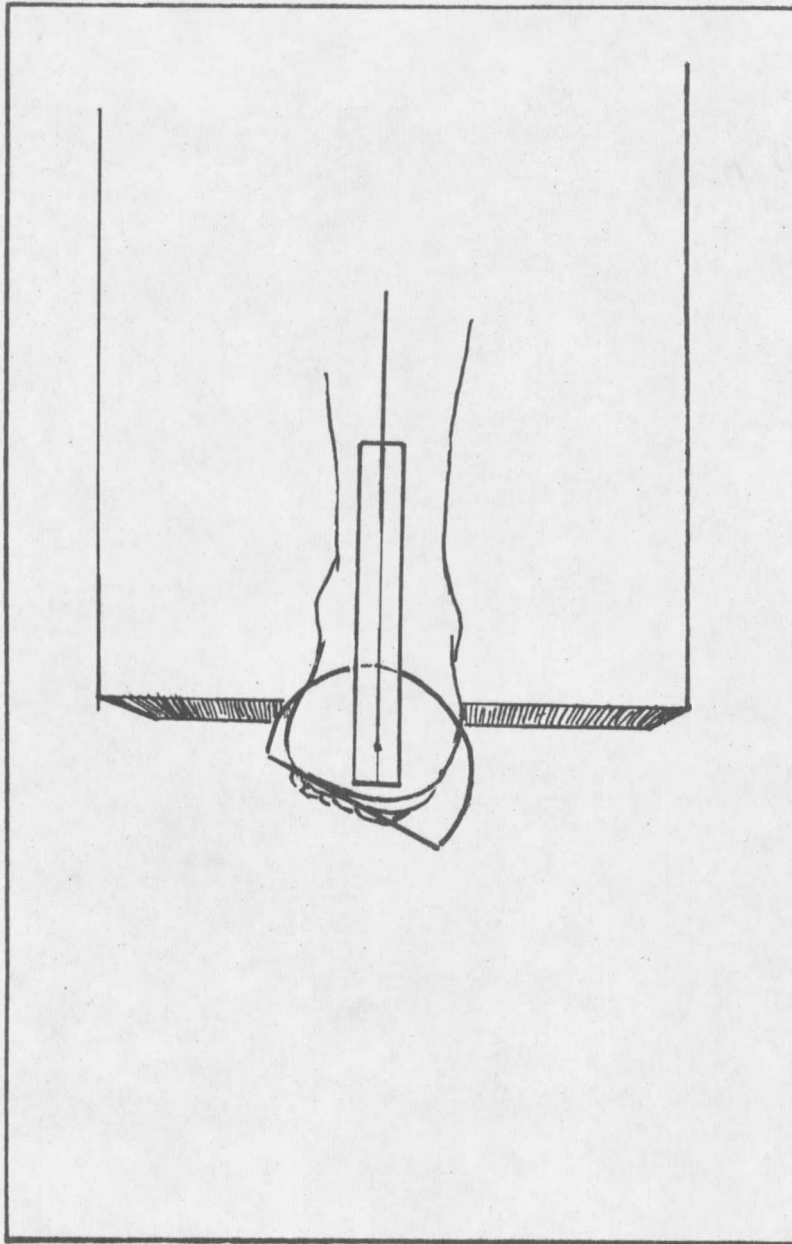


Figure 15. Determining eversion at the subtalar joint

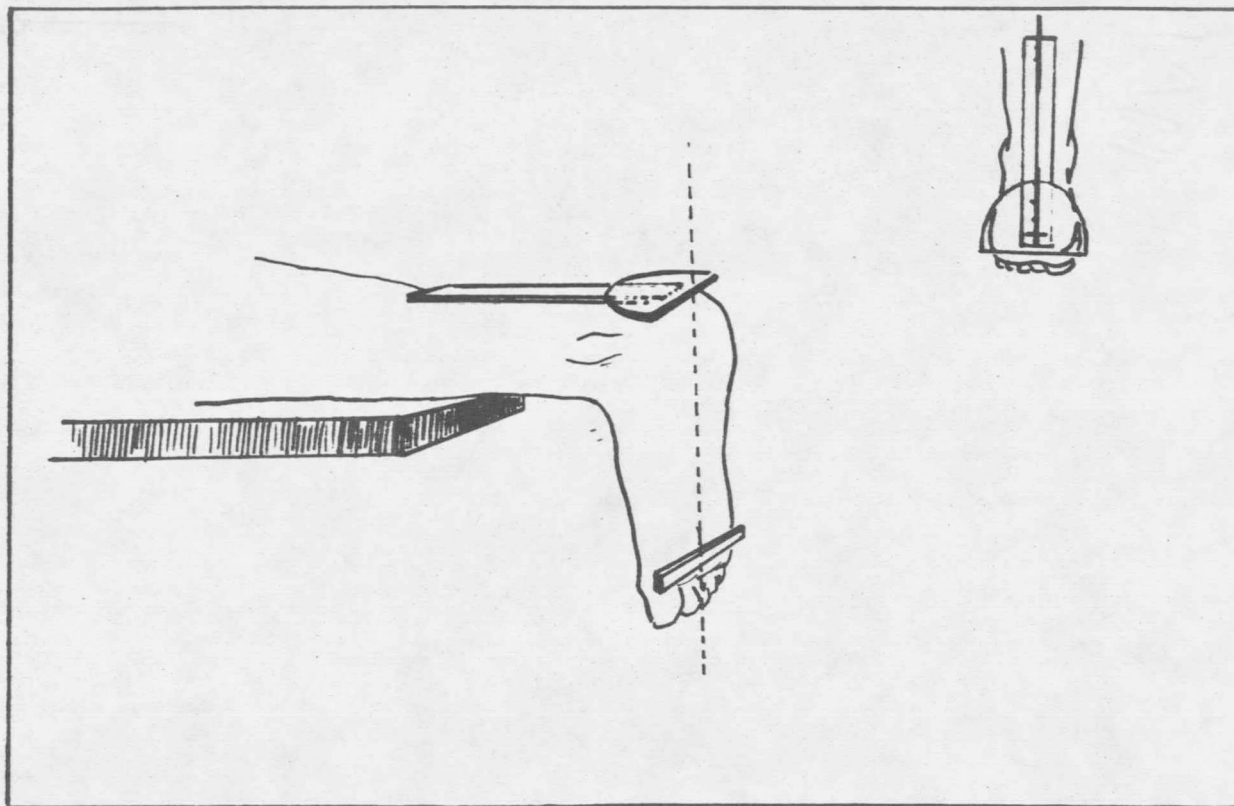


Figure 16. Determining the position of the forefoot in relationship to the rearfoot/
subtalar joint neutral

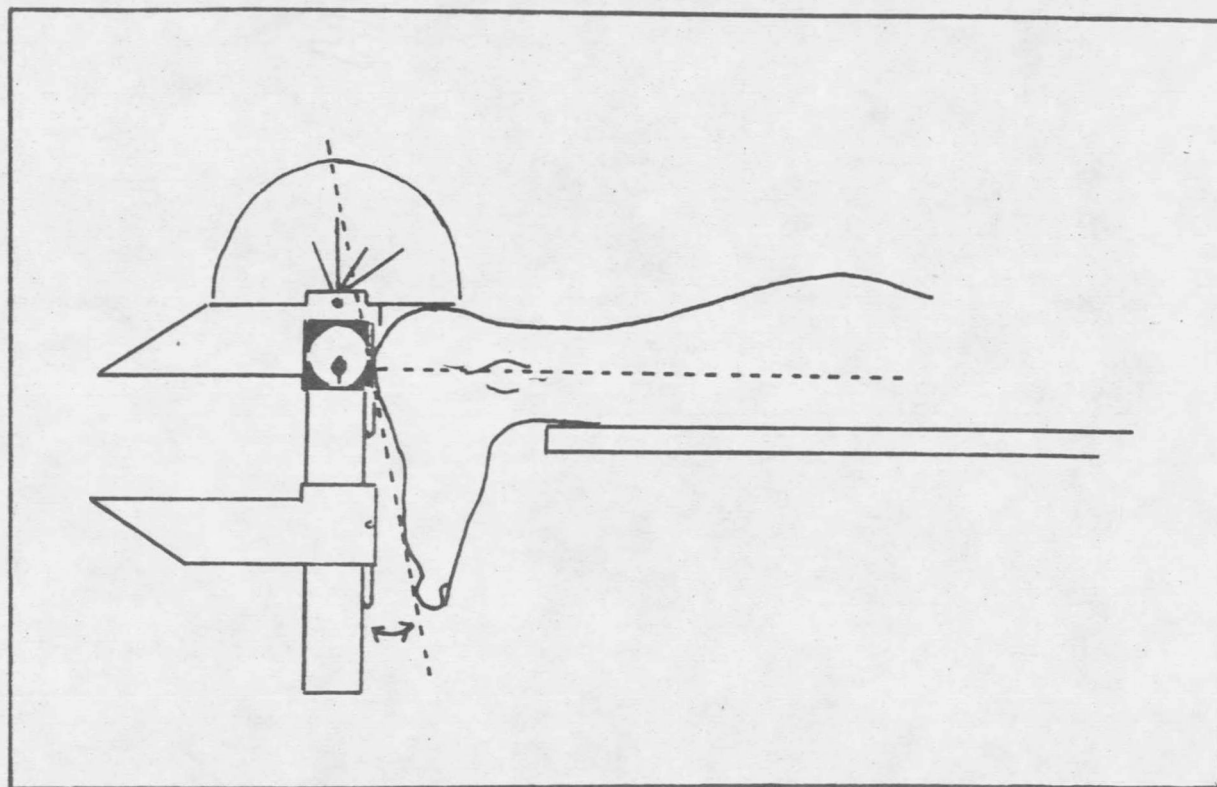


Figure 17. Determining dorsiflexion of the ankle/knee extended

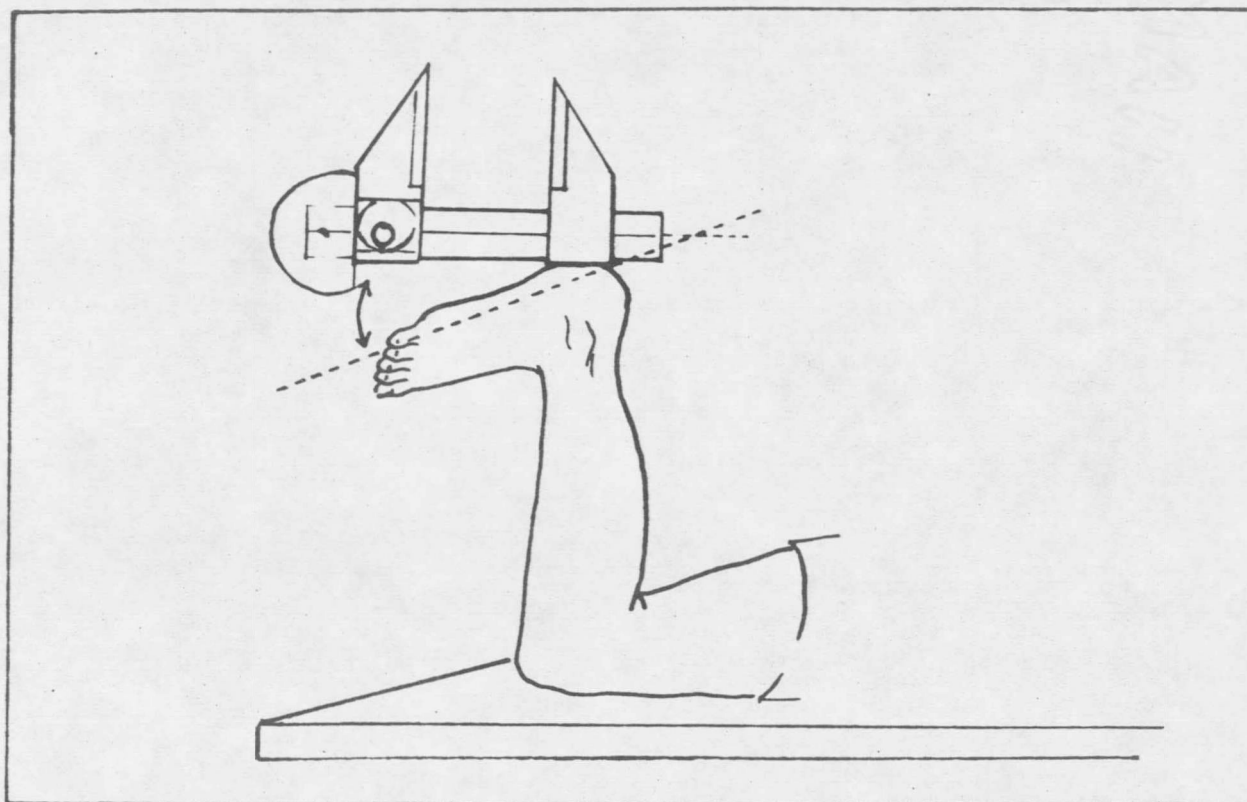


Figure 18. Determining dorsiflexion of the ankle/knee flexed

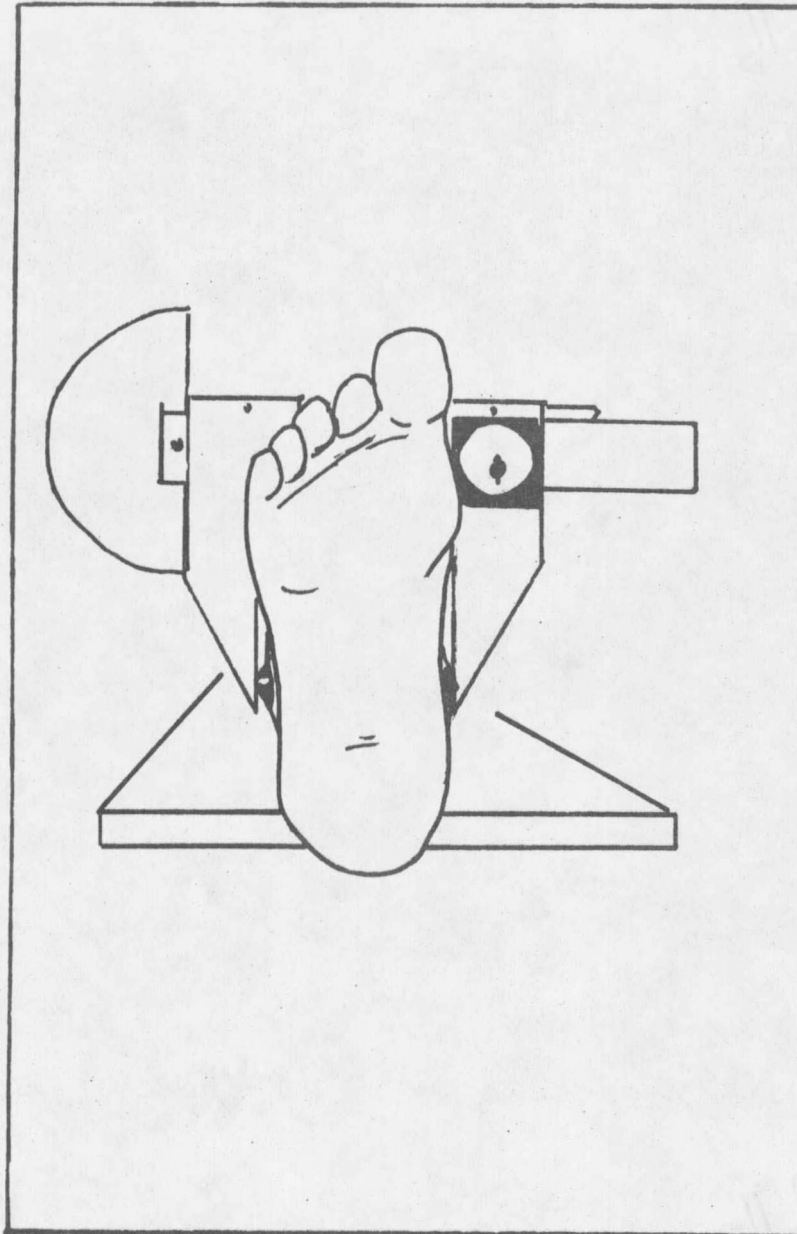


Figure 19. Determining the position of the malleoli/subtalar joint neutral

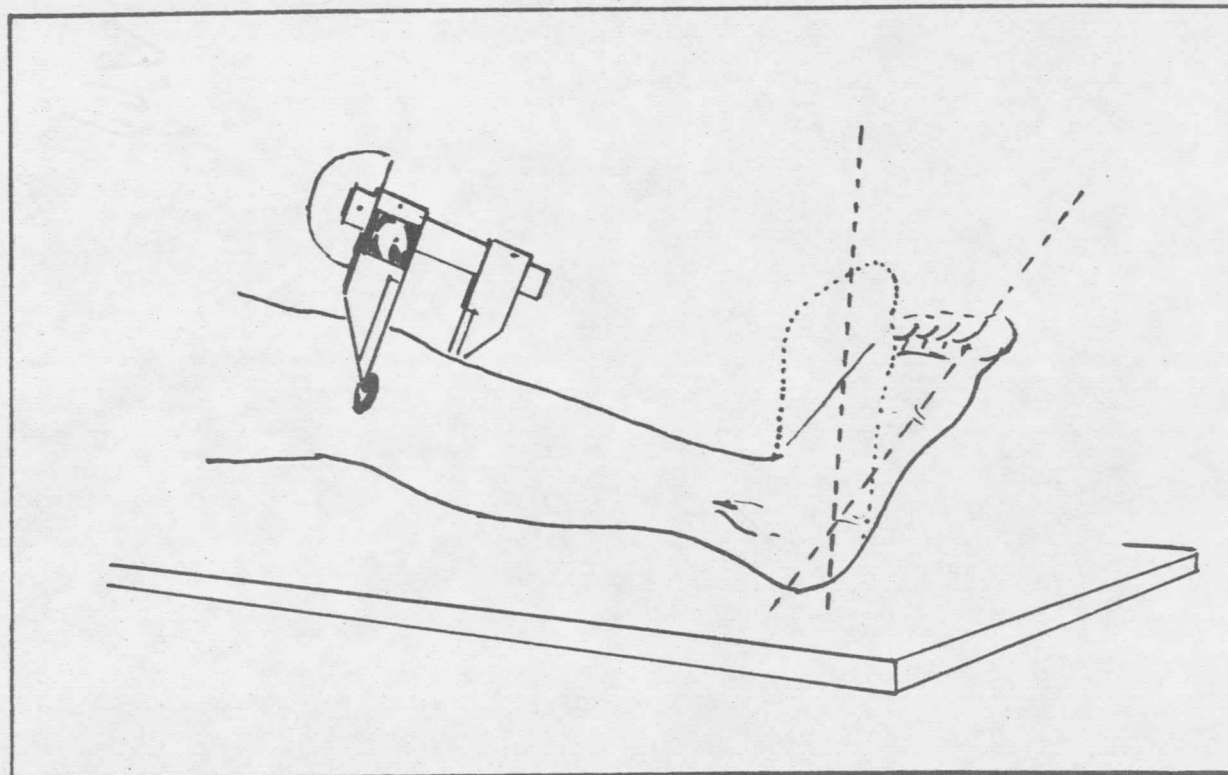


Figure 20. Determining internal rotation of the femur/hip extended

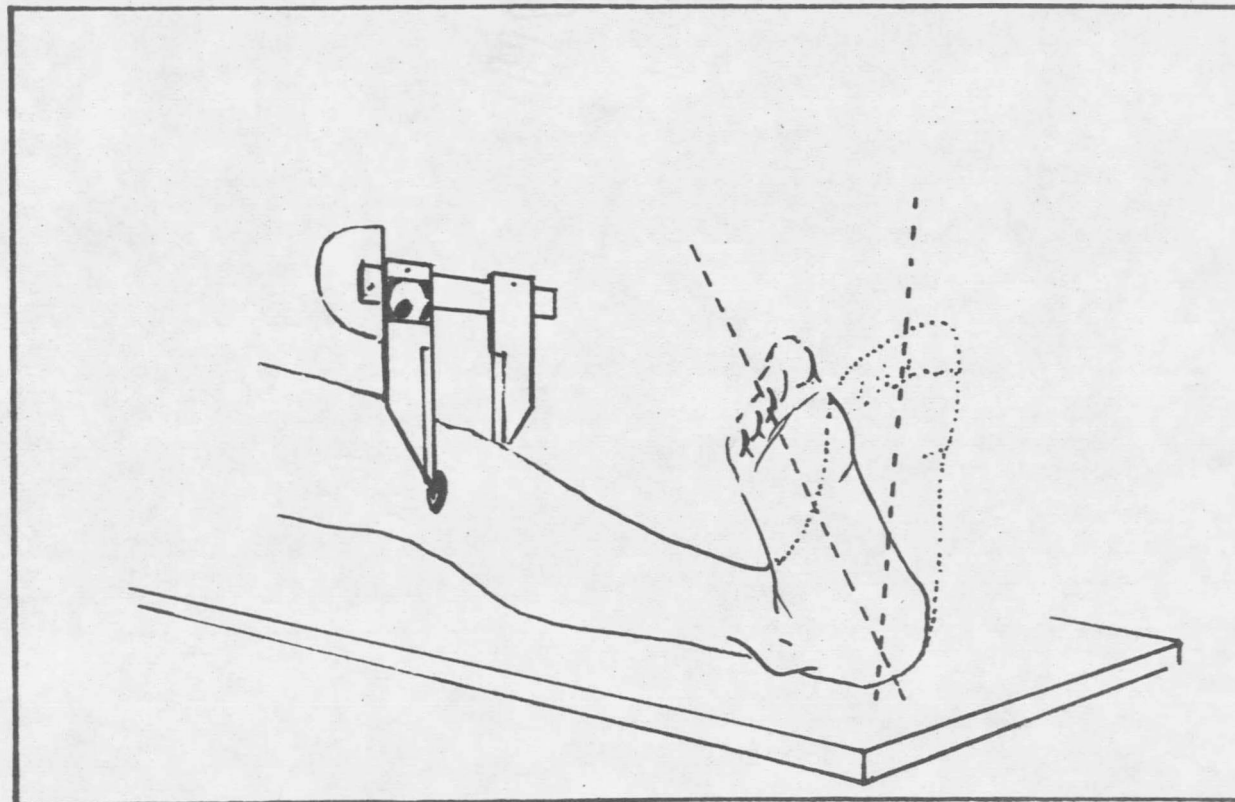


Figure 21. Determining external rotation of the femur/hip extended

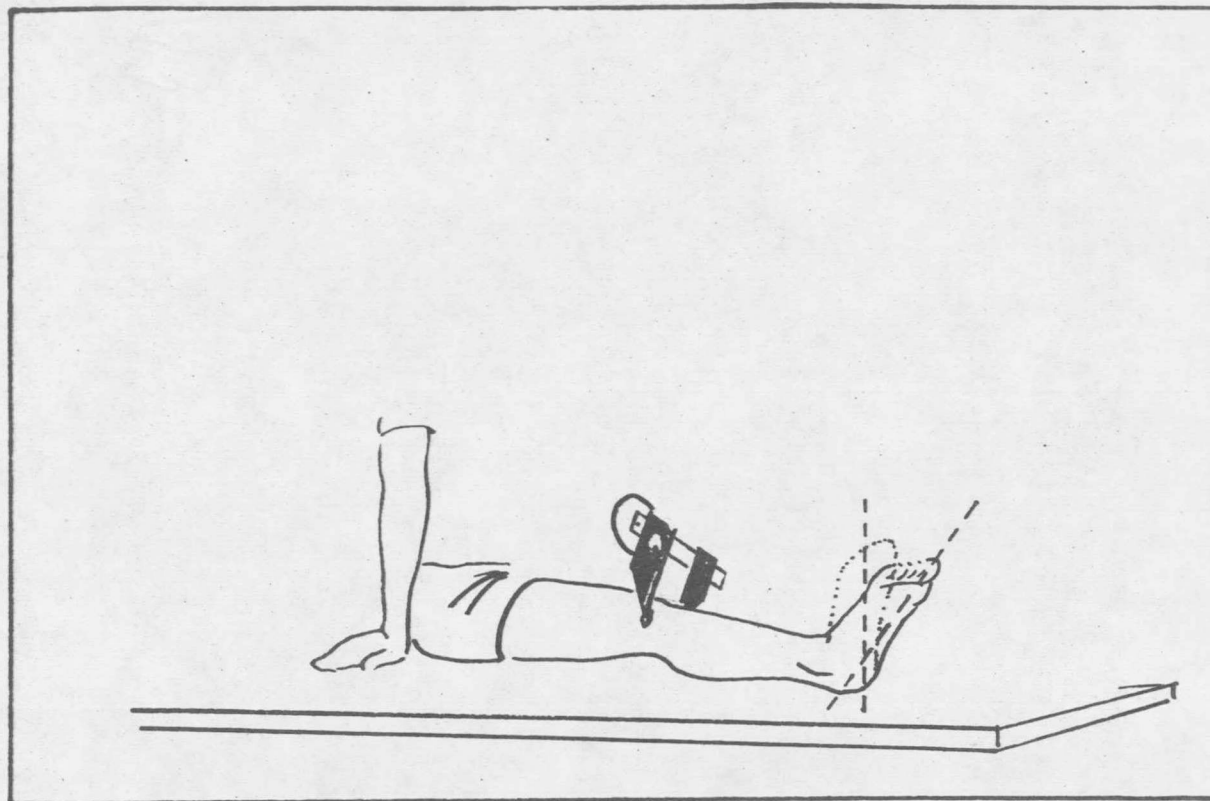


Figure 22. Determining internal rotation of the femur/hip flexed

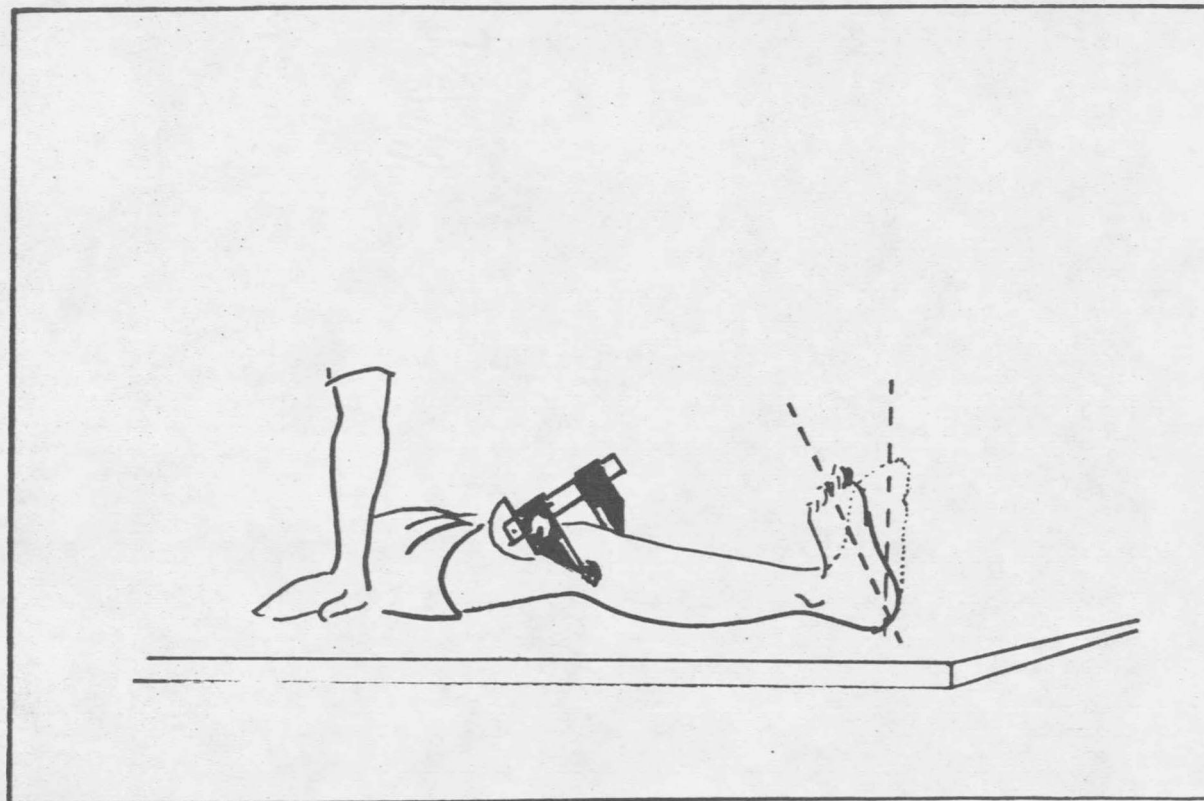


Figure 23. Determining external rotation of the femur/hip flexed

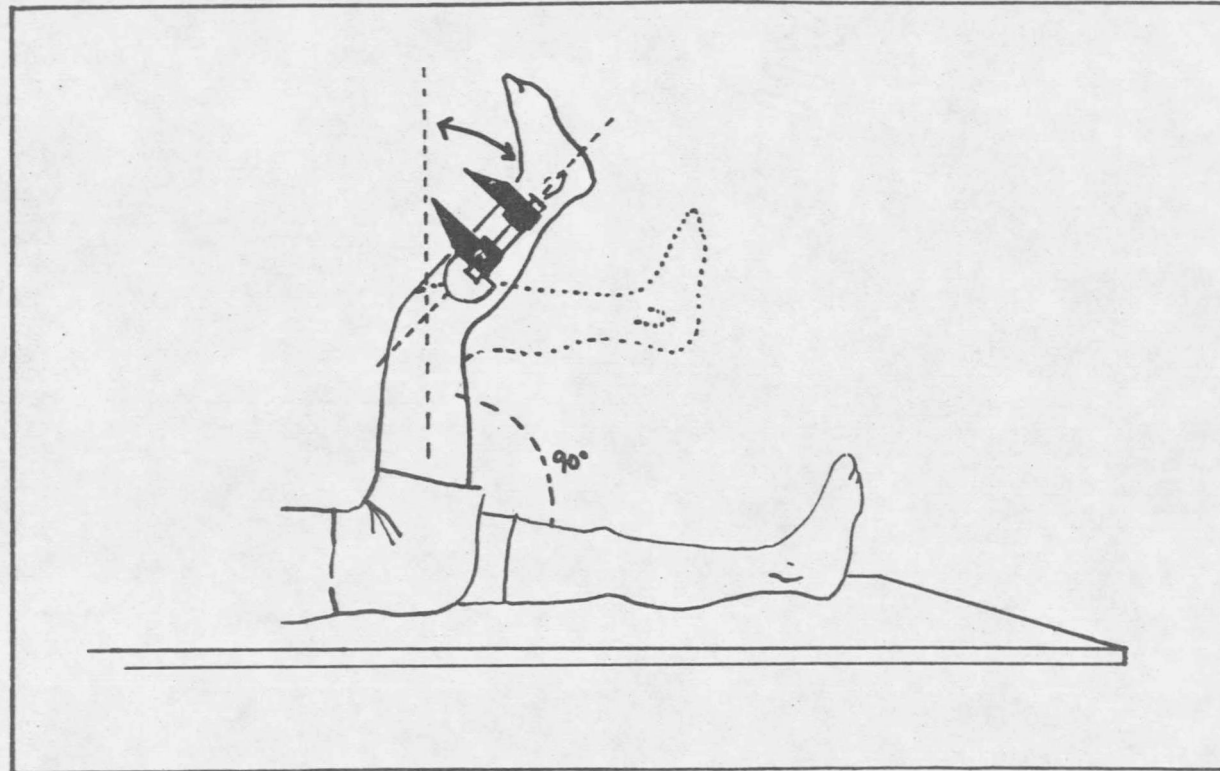


Figure 24. Determining flexibility of the hamstring muscle group

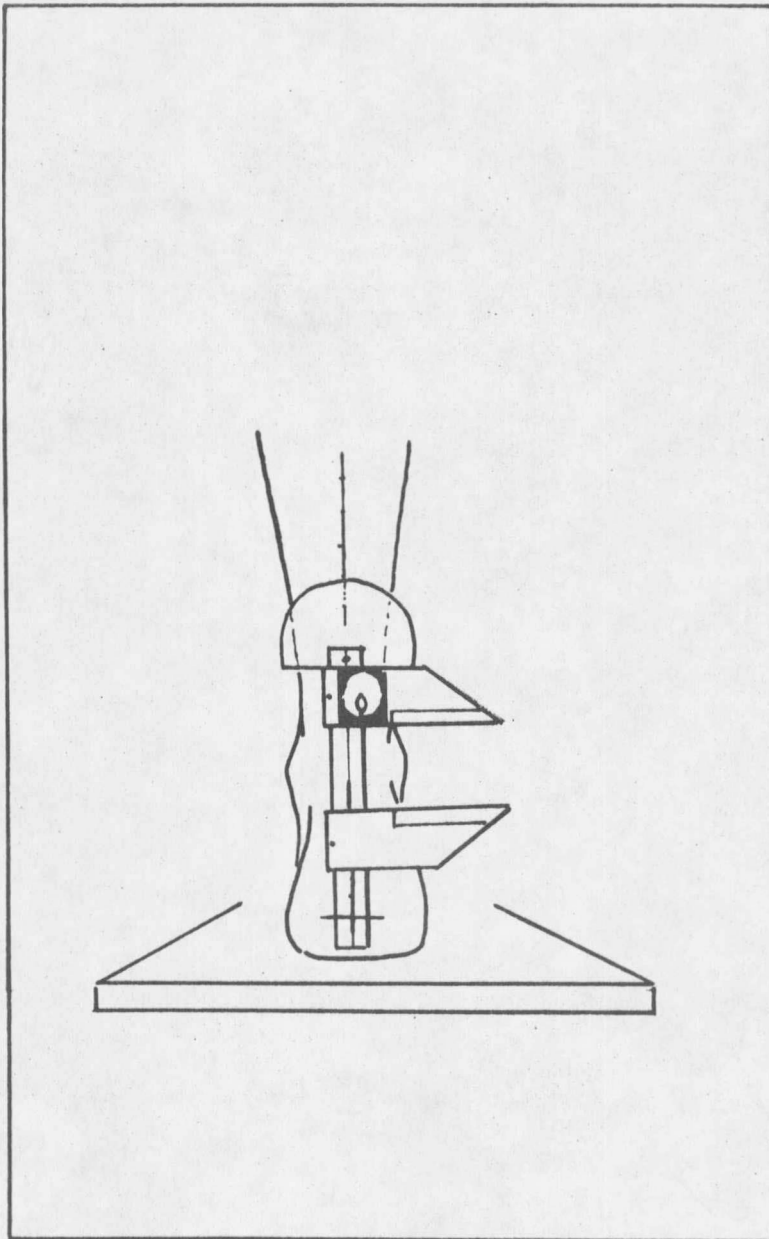


Figure 25. Determining the position of the calcaneus with the subtalar joint in either static or neutral position

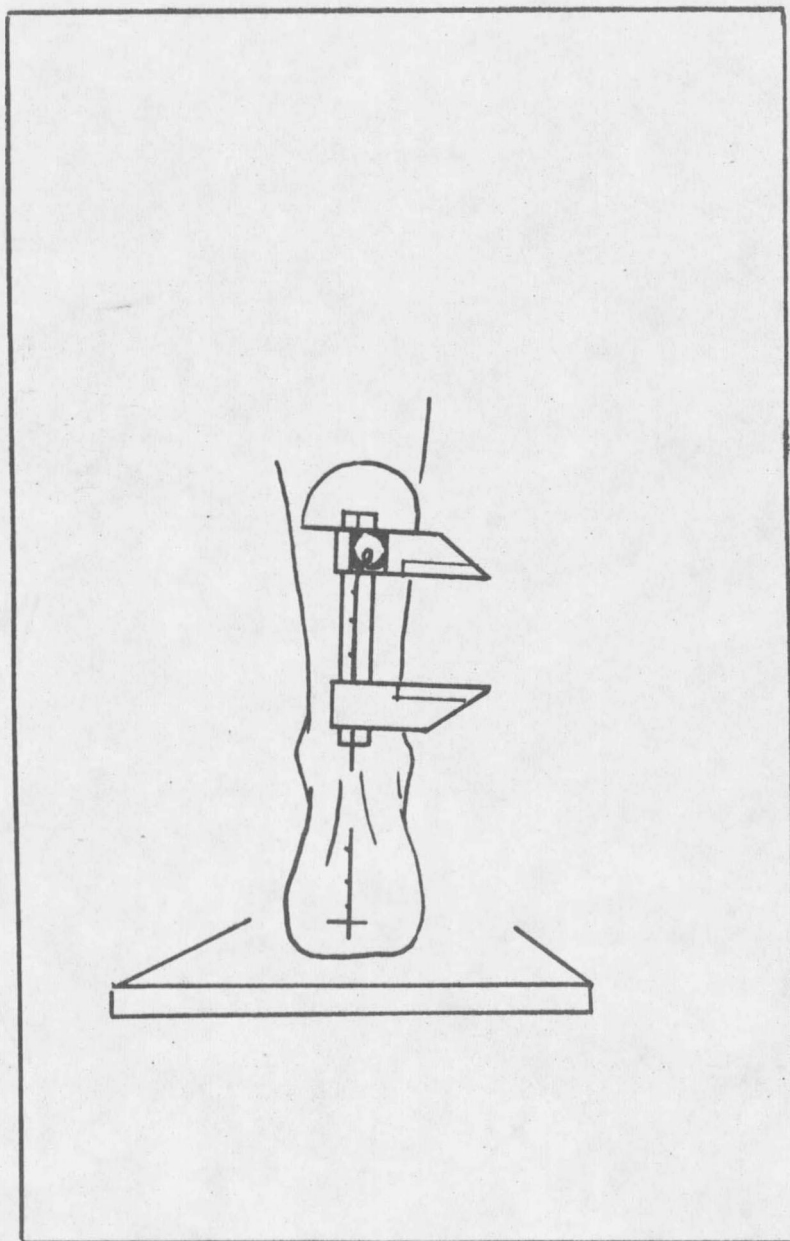


Figure 26. Determining the position of the lower leg with the subtalar joint in either static or neutral position

Researcher Reliability

A pilot study was conducted to determine coefficients of reliability for the measurement techniques and manners in which the evaluations of the subjects were accomplished.

During the week of February 23-27, 1976, ten female students attending Montana State University were selected at random from those students using the women's locker room facilities. These ten students were not eligible to be subjects in the actual study. Two appointments were made with each of the ten women. During each appointment, each subject was given a complete biomechanical examination of the lower extremity, i.e., each of the fifteen tests was performed on both the left and the right legs. Data were recorded on an Examination Chart (Appendix A). Care was taken by the researcher to insure that identical examination procedures were followed during each evaluation. The first appointment served as a test period, and the second one served as a retest period.

Upon completing two examinations on each of the ten subjects, data were transferred to computer programming forms by the investigator. Data were then run through the computer according to a program written by a member of the testing and counseling department (27) at Montana State University. The program was designed to compare the results of the fifteen measurements taken at the time of the first appointment to the corresponding fifteen measurements taken at the

time of the second appointment. Since the researcher was attempting to determine coefficients of reliability as per technique of the examination, and since the techniques used to examine the left and right legs were identical, no differentiation was made between data from the left leg and data from the right leg. Since the data collected from both the right and left legs of the subjects were used for comparison of each evaluation technique, there were twenty subjects for the pilot study.

The correlation values obtained from the printout were compared to the critical values (N=20) at the .05 level (.444). However, the techniques used by the investigator to examine the lower extremity and determine the following measures were found to be reliable at the .01 level of confidence when compared to the critical value of .561 for N=20:

1. inversion of the subtalar joint ($r = .86737$)
2. eversion of the subtalar joint ($r = .82542$)
3. dorsiflexion of the ankle with the knee extended
($r = .56849$)
4. dorsiflexion of the ankle with the knee flexed ($r = .60517$)
5. internal rotation of the femur with the hip extended
($r = .72487$)
6. internal rotation of the femur with the hip flexed
($r = .84597$)

7. external rotation of the femur with the hip flexed
($r = .60884$)
8. flexibility of the hamstring muscle group ($r = .65058$)
9. position of the forefoot in relationship to the rearfoot
with the subtalar joint neutral ($r = .78703$)
10. position of the malleoli with the subtalar joint neutral
($r = .66349$)
11. position of the frontal plane of the tibia with the sub-
talar joint static ($r = .65530$)
12. position of the frontal plane of the tibia with the sub-
talar joint neutral ($r = .73564$)
13. position of the calcaneus in relationship to the floor
with the subtalar joint static ($r = .84898$)

The researcher's techniques used to determine the degree of external rotation of the femur with the hip extended and the position of the calcaneus in relationship to the floor with the subtalar joint neutral were significant at the .05 level with respective r values of .55719 and .51516.

All examination methods were accepted as reliable at the .05 level of confidence.

Subject Selection

The names of prospective subjects were obtained by the investigator through interviews with head coaches for women's athletics at Montana State University and surrounding area high schools. Prospective subjects were contacted and interviewed using the subject selection questionnaire (Appendix B). Symptoms and treatment were recorded. Information was reviewed by the athletic trainer at Montana State University (5) who then verified the existence or non-existence of the shin splint syndrome. Persons who had been or who were currently competing in women's athletics at the varsity level and who were diagnosed by the trainer as either having no shin splints, having shin splints, or having had shin splints previously were accepted as subjects for the study. Persons who were known to have injuries of the lower extremity other than the shin splint syndrome were eliminated from the study. Also, if a subject had been diagnosed as having had shin splints previously or having shin splints currently in one leg only, then only the data from the afflicted leg were used in the study.

Subject Description

Thirty-two women athletes from Montana State University and surrounding area high schools served as subjects for this study. Ages

ranged from fourteen to twenty-six years, with height and weight varying from 5'1" to 5'9" and 98 to 160 pounds, respectively.

Subject Classification

A quasi-experimental design was used for the study. Subjects, upon selection, had their leg(s) classified into the following groups:

Group 1-No Shin Splints: Legs that had never been afflicted with shin splints or other trauma were placed in this group. If an individual had one leg that was injury free, while the other leg was experiencing or had experienced some trauma such as sprained ankles, or knee injuries, only the injury free leg was included in this group. The other leg was eliminated from the study (N=18).

Group 2-Current Moderate Shin Splints: Subjects who were diagnosed as having shin splints in both legs, but who complained of one leg hurting more than the other, had the less severe leg placed in Group 2 and the more severe leg placed in Group 3. Legs placed in Group 2 were those legs that gave the subjects less pain as compared to the other leg (N=5).

Group 3-Current Severe Shin Splints: Subjects who were diagnosed as having shin splints in both legs and who did not distinguish between the severity of the ailment, i.e., they did not complain of one leg hurting more than the other leg, had both legs placed in Group 3. Subjects who did distinguish between the severity of the ailment

from one leg to the other had the more severe leg placed in Group 3 and the less severe leg placed in Group 2 (N=19).

Group 4-Previous Shin Splints: Subjects who had been previously diagnosed as having shin splints but who, at the time of this examination were not suffering from any trauma of the lower extremity were placed in this group. If an individual had had shin splints in one leg but not in the other leg, only the afflicted leg was used (N=14).

Group 5-Current Shin Splints: Group 2 (current moderate shin splints) and Group 3 (current severe shin splints) were combined to form this group (N=24).

By definition of the nature of Group 2 and Group 3 it was possible for a subject to have one leg placed in each of the two groups. Verification of the existence or non-existence of the shin splint syndrome by the athletic trainer at Montana State University was used to place the legs of each subject within the various groups.

Subject Examination

Subjects for the study were examined between April 5, 1976 and April 19, 1976. Measures of each of the specific parameters to be considered were taken by the investigator with a manual biometer developed by Phillips (12). Data were recorded on Examination Charts (Appendix A) also provided by Phillips (12).

Statistical Analysis of Data

An analysis of variance was done to determine whether the alignment of the lower extremity, as defined by the fifteen measures, was significantly different between the no shin splint group (G-1), the previous shin splint group (G-4), and the current shin splint group (G-5). A Duncan's Test was used to determine which of the mean measures were significantly different between the same three groups.

A step-wise regression analysis was performed to interpret the data from the no shin splint group (G-1), the current moderate shin splint group (G-2) and the current severe shin splint group (G-3). The step-wise regression provided the basis for determining the relative importance of the selected measurements of the lower extremity to the relative severity of the shin splint syndrome and which of the measurements, if any, could be used to predict the occurrence of the shin splint syndrome.

Chapter 4

RESULTS

Data from the study were analyzed through the use of an analysis of variance, a Duncan's Test, and a step-wise regression.

Description of Population

The analysis of variance served as the basis for determining whether or not specific populations could be independently described according to the fifteen selected measures of the lower extremity, i.e., was the alignment of the lower extremity, as defined by the fifteen measures, significantly different between persons who had no shin splints (G-1), persons who had previously had shin splints (G-4), and persons who currently had shin splints (G-5).

The analysis of variance indicated that there were significant lower extremity alignment differences between each of the above mentioned groups ($p < .01$). Results of the analysis of variance are shown in Table 1. Results further indicated that it was possible to describe the three specific populations according to the alignment of the lower extremity. Thus, the alternate hypothesis which stated that it would be possible to describe these three specific populations according to the alignment of the lower extremity was accepted.

Table 1. Summary of the analysis of variance

Source	df	SS	MS	F ratio	Critical Value ($p < .05$)
Groups	2	77.5189	38.7594	15.966*	3.00
Treatment	14	26555.9	1896.85	78.382*	1.75
Group X Treatment	28	203.175	7.25623	2.989*	1.52
Error	795				

* Significant beyond $p < .01$

Specific Measure Differences

Since the analysis of variance indicated that each of the three groups was significantly different, a Duncan's Test was then applied to the means of each of the measures to determine which of the mean measures were significantly different between each of the three groups. Results of the Duncan's Test are summarized in Table 2.

Six of the fifteen measurements taken were significantly different ($p < .05$) between each of the three groups. These measurements included the ranges of: external and internal rotation of the femur/hip flexed and extended, dorsiflexion of the ankle/knee flexed, and flexibility of the hamstring muscle group.

The measurements of the position of the calcaneus in relationship to the floor/subtalar joint static and the position of the tibia/subtalar neutral showed no significant difference ($p < .05$) between any of the three groups.

Table 2. Summary of Duncan's Test analysis

Variables	$\bar{X}_1$	$\bar{X}_4$	$\bar{X}_5$	Sig. diff (p < .05)
1 External rotation of femur/hip extended	51.39	57.64	64.96	abc
2 Dorsiflexion of ankle/knee flexed	16.56	17.79	20.33	abc
3 Inversion of subtalar joint	16.61	15.86	19.96	bc
4 Position of tibia/subtalar joint static all measurements varum	3.833	5.643	5.667	ab
5 Dorsiflexion of ankle/knee extended	31.61	33.00	31.08	ac
6 Position of calcaneus/subtalar joint static all measurements inversion	2.333	2.071	2.750	
7 Flexibility of hamstrings	7.444	2.357	9.542	abc
8 Position of tibia/subtalar joint neutral all measurements varum	.5000	.7857	.7500	
9 Internal rotation of femur/hip extended	67.44	61.50	72.17	abc
10 Internal rotation of femur/hip flexed	64.06	61.93	66.04	abc
11 Eversion of subtalar joint	13.83	13.50	14.75	c
12 Position of calcaneus/subtalar joint neutral all measurements inversion	2.278	.3571	2.042	ac
13 External rotation of femur/hip flexed	51.11	54.79	62.17	abc
14 Position of malleoli/subtalar joint neutral all measurements external	17.06	16.36	14.62	bc
15 Position of forefoot to rearfoot/subtalar joint neutral, -.2222 refers to valgum, other measurements varum	-.2222	2.643	2.042	ab
a Significantly different between groups 1 and 4 (p<.05)				
b Significantly different between groups 1 and 5 (p<.05)				
c Significantly different between groups 4 and 5 (p<.05)				

In addition, those legs with no shin splints differed from those legs which currently had shin splints in the ranges of inversion at the subtalar joint, and the positions of the forefoot in relationship to the rearfoot/subtalar joint neutral, malleoli/subtalar joint neutral, and frontal plane of the tibia/subtalar joint static. These results are illustrated in Figures 27 and 28. Those legs with no shin splints differed from those with previous shin splints in the range of dorsiflexion of the ankle joint/knee extended, and the positions of the forefoot to the rearfoot/subtalar joint neutral; frontal plane of the tibia/subtalar joint static; calcaneus in relationship to the floor/subtalar joint neutral. Figures 29 and 30 represent these relationships.

And finally, those legs with previous shin splints differed from those with shin splints in the ranges of inversion and eversion at the subtalar joint, dorsiflexion at the ankle joint/knee extended, and the positions of the malleoli/subtalar joint neutral, and the calcaneus in relationship to the floor/subtalar joint neutral. Figures 31 and 32 illustrate the relationship between the previous shin splint group (G-4) and the current shin splint group (G-5).

Relative Contribution of Measures to Alignment

A step-wise regression analysis was performed to determine the relative importance of the fifteen measures of the lower extremity to

MEAN MEASUREMENT COMPARISON

of

GROUP 1 - NO SHIN SPLINTS AND

GROUP 5 - CURRENT SHIN SPLINTS

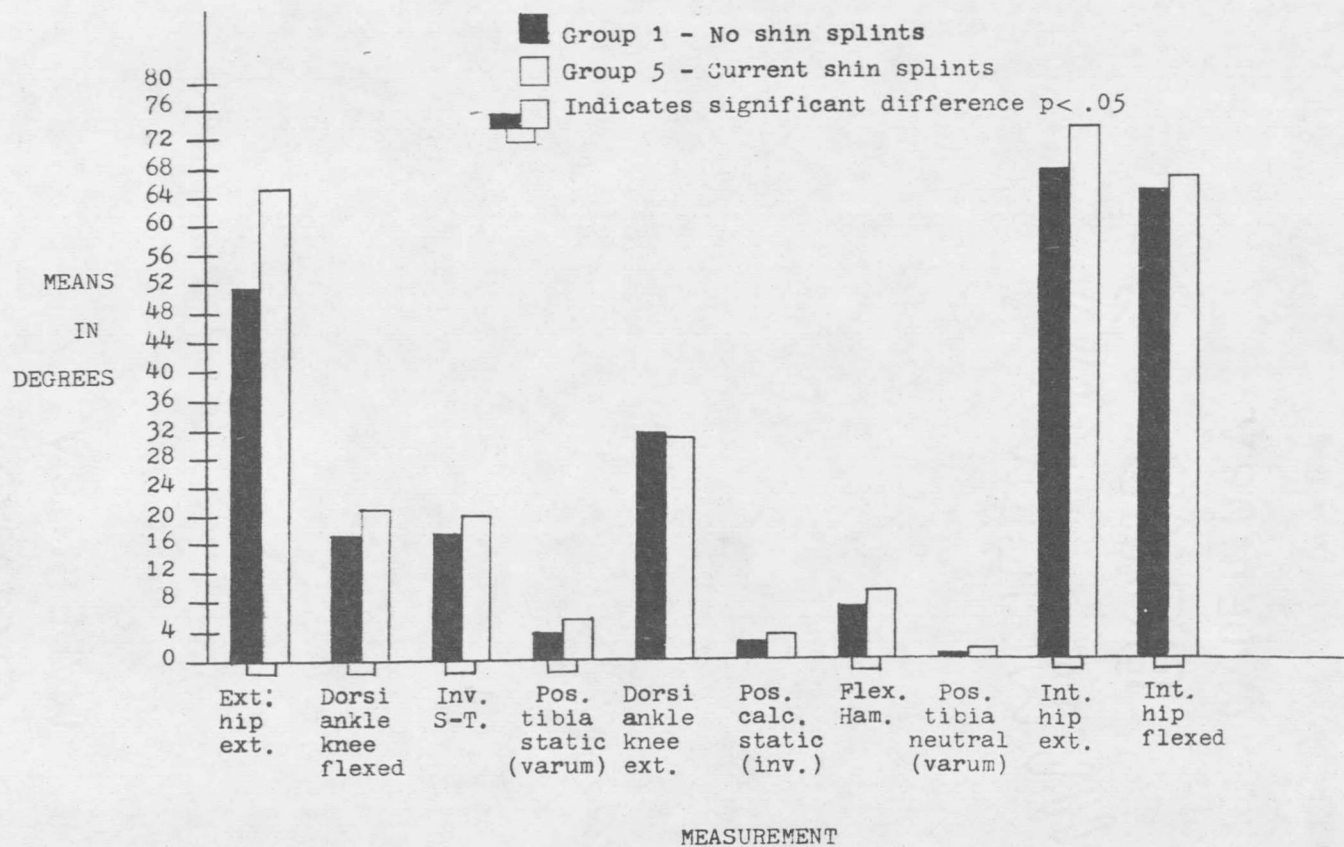


Figure 27

MEAN MEASUREMENT COMPARISON
of
GROUP 1 - NO SHIN SPLINTS AND
GROUP 5 - CURRENT SHIN SPLINTS

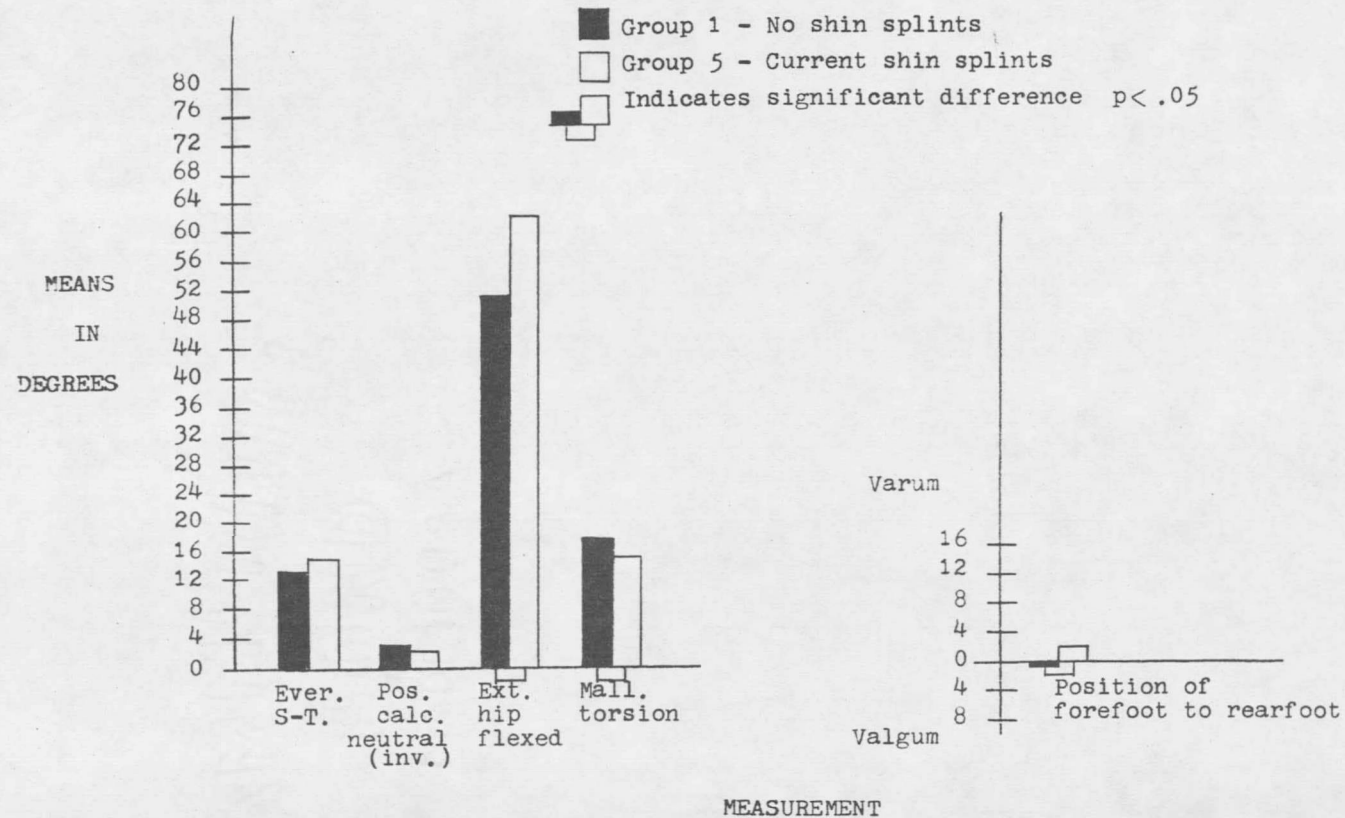


Figure 28

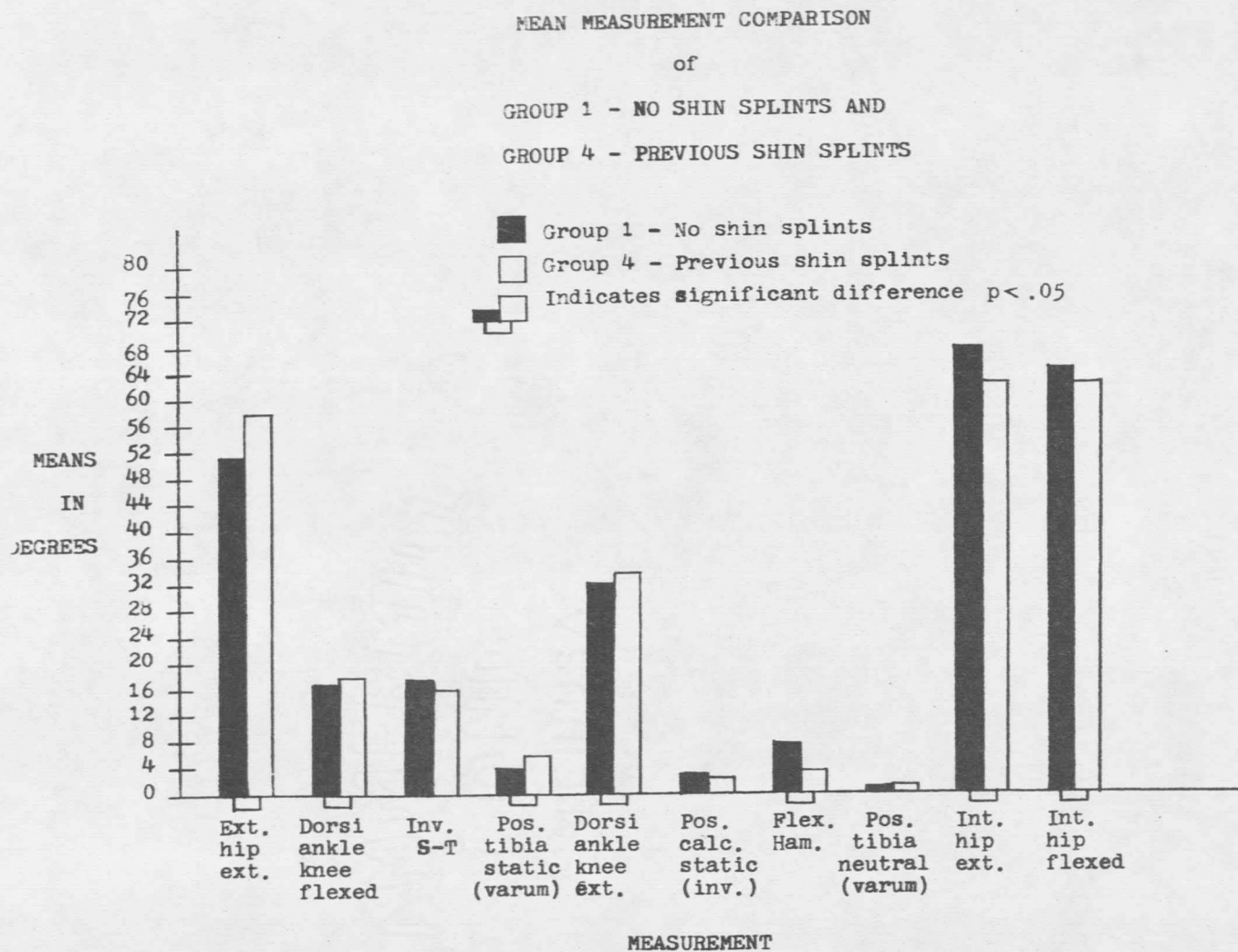


Figure 29

MEAN MEASUREMENT COMPARISON

of

GROUP 1 - NO SHIN SPLINTS AND

GROUP 4 - PREVIOUS SHIN SPLINTS

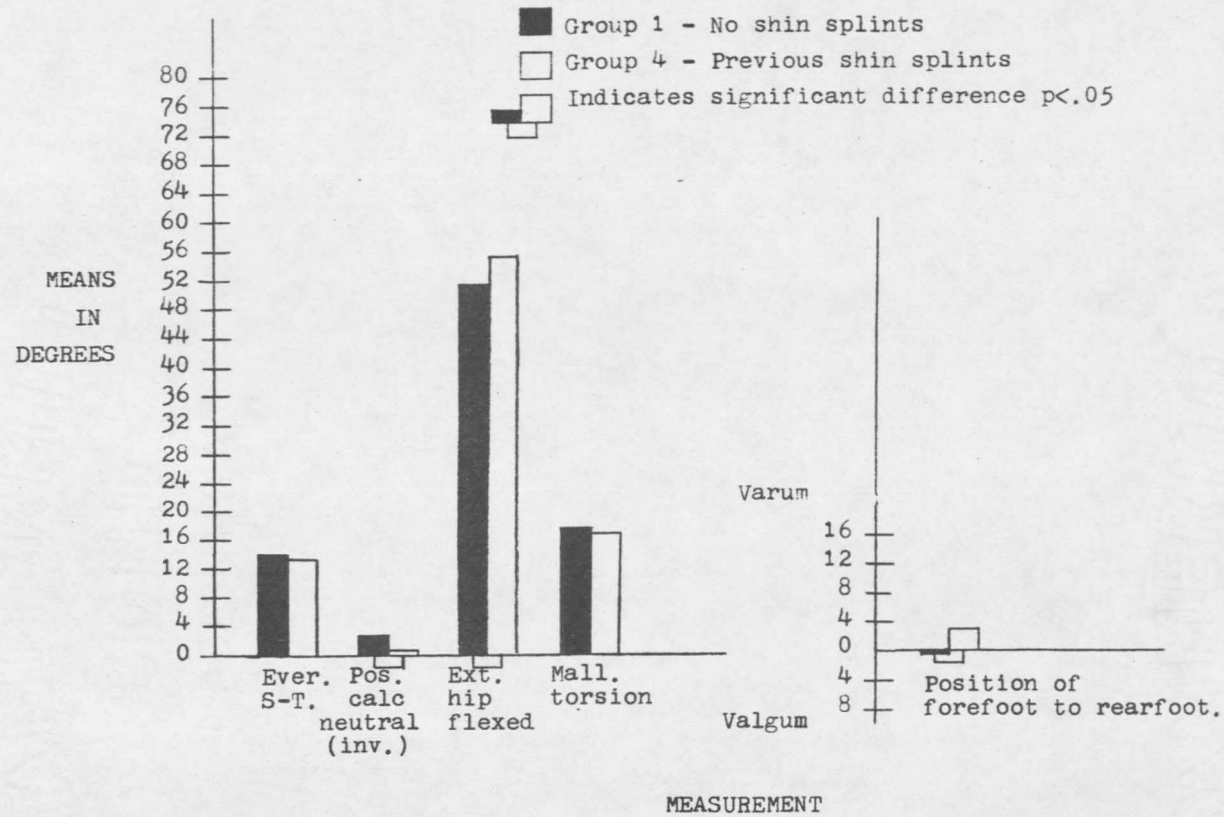


Figure 30

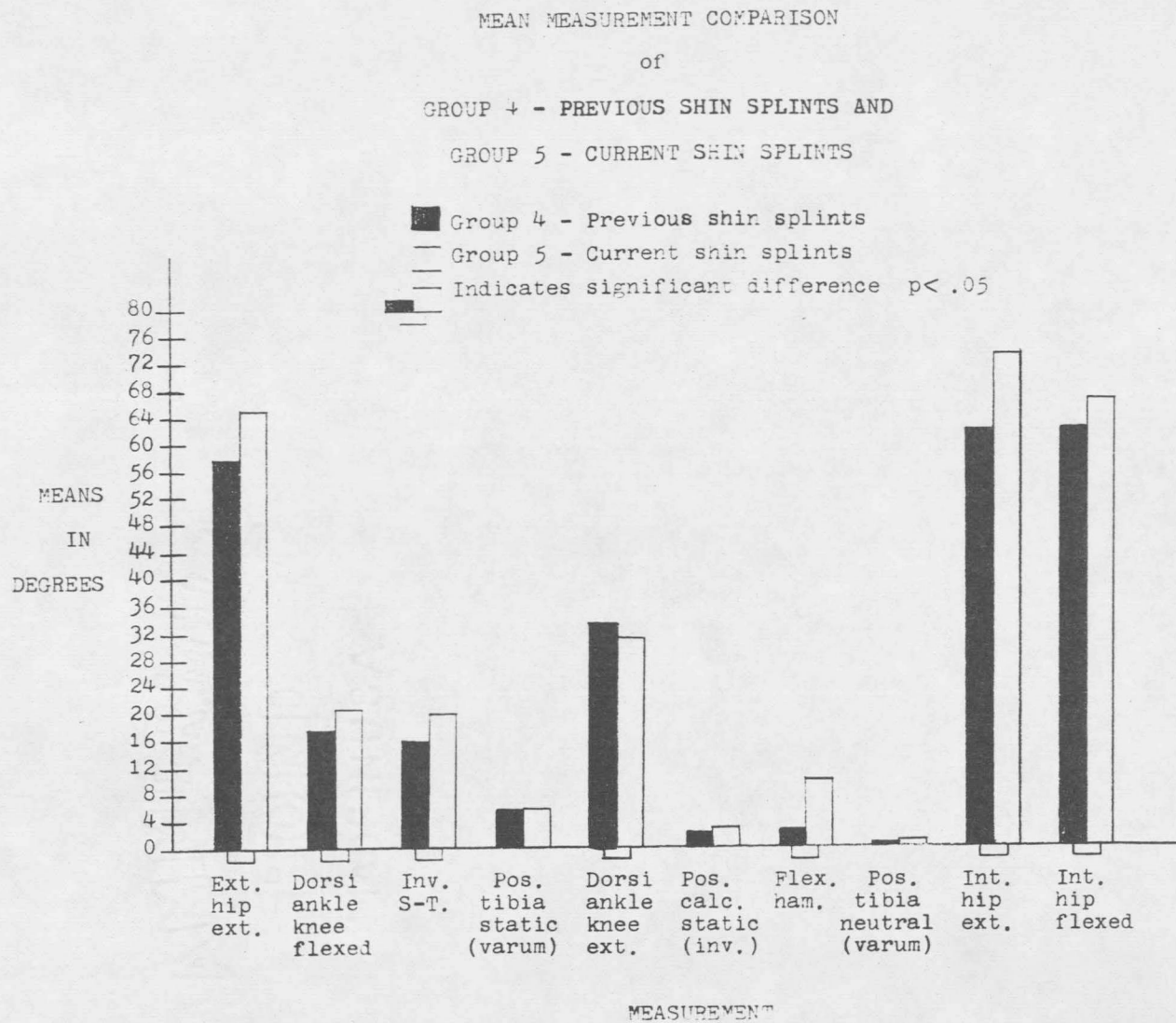


Figure 31

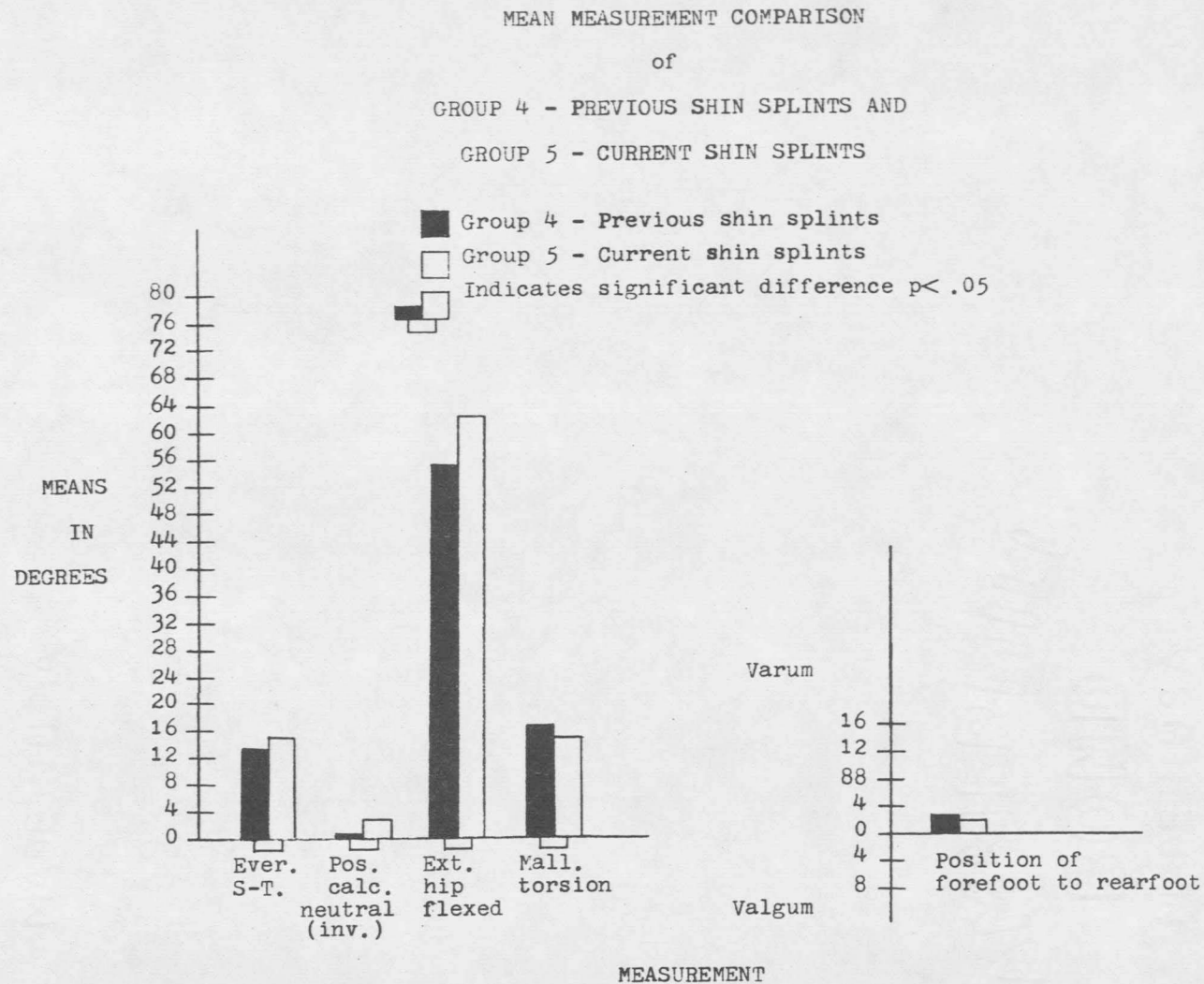


Figure 32

the relative severity of the shin splint syndrome, and which of these measures, if any, could best be used to predict the occurrence of the shin splint syndrome. Subjects' legs were grouped according to a severity index established by the investigator and data from these groups (the no shin splint group G-1, the current moderate shin splint group G-2, and the current severe shin splint group G-3) were incorporated into the regression. Results of the step-wise regression are summarized in Table 3.

According to the results of the regression, six measures of the lower extremity could best be used to predict the occurrence of the shin splint syndrome on the anterior medial aspect of the tibia. The suggested predictive measures were the ranges of external rotation of the femur with the hip extended, dorsiflexion of the ankle with the knee both flexed and extended, and inversion of the subtalar joint and the positions of both the tibia and the calcaneus with the subtalar joint static. The measures of hamstring flexibility and the position of the tibia with the subtalar joint neutral approach significant levels and their respective F-values to enter appear to be higher than the remaining measures. All other measures did not appear to increase the predictability of the shin splint syndrome significantly.

Table 3. Summary of the step-wise regression analysis

Step Number	Variable entered	Multiple R	RSQ	Increase in RSQ	F Value to enter
1	External rotation of femur/hip extended	.4110	.1689	.1689	10.9774*
2	Dorsiflexion of ankle/knee flexed	.5830	.3398	.1709	13.7200*
3	Inversion of subtalar joint	.6680	.4462	.1064	9.9892*
4	Position of tibia/subtalar joint static	.6928	.4800	.0338	3.3164*
5	Dorsiflexion of ankle/knee extended	.7133	.5088	.0288	2.9303*
6	Position of calcaneus/subtalar joint static	.7333	.5377	.0289	3.0657*
7	Flexibility of hamstrings	.7470	.5581	.0203	2.2065
8	Position of tibia/subtalar joint neutral	.7576	.5740	.0159	1.7543
9	Internal rotation of femur/hip extended	.7588	.5758	.0019	.2048
10	Internal rotation of femur/hip flexed	.7645	.5845	.0087	.9387
11	Eversion of subtalar joint	.7652	.5855	.0010	.1073
12	Position of calcaneus/subtalar joint neutral	.7658	.5865	.0009	.0984
13	External rotation of femur/hip flexed	.7663	.5872	.0008	.0790
14	Position of malleoli/subtalar joint neutral	.7663	.5873	.0000	.0041
15	Position of forefoot to rearfoot/subtalar joint neutral	.7663	.5873	.0000	.0004

* Value significant $p < .05$

The alternate hypotheses which stated that the measures could be used to predict the occurrence of the shin splint syndrome were accepted for the following measures:

1. external rotation of the femur with the hip extended
2. dorsiflexion of the ankle with the knee flexed
3. inversion of the subtalar joint
4. position of the tibia with the subtalar joint static
5. dorsiflexion of the ankle with the knee extended
6. position of the calcaneus with the subtalar joint static

The null hypotheses were accepted concerning all other measures.

Chapter 5

DISCUSSION

As indicated by the analysis of variance, it was possible to independently describe populations of persons who never had shin splints, persons who had shin splints previously, and persons who currently had shin splints according to the alignment of the lower extremity. The idea that people with shin splints have a different lower extremity alignment than people without shin splints would seem to be partially supported by the fact that shin splints may occur in one athlete, and yet not in another, even though both athletes are of similar condition and are engaged in equally stressful training programs (5). Trainers, doctors, and athletes note that certain persons seem to be predisposed to the shin splint syndrome, i.e., some persons get shin splints while others do not. Although the predisposing factors are not yet known, the study supported the contentions of Sheehan (21), Hlavac (4), Subotnick (22) and others that the alignment of the lower extremity is related in some way to the occurrence of shin splints.

A Duncan's Test indicated that there were significant mean measure differences between certain specific measurements within each of the three groups. Although previous researchers (4,21,22) suggested that the shin splint syndrome was related to the alignment of the foot and/or lower leg, no specific measurements were mentioned

as being related to the syndrome. However, indirectly, references were made to the specific conditions of excessive or prolonged pronation, transverse plane abnormalities, and sagittal plane abnormalities (such as tightness of the hamstring muscle group) and their relationships to the shin splint syndrome (26:77).

The study found that persons with shin splints had increased tibial varum when the subtalar joint was neutral, and slightly increased inversion of the calcaneus when the subtalar joint was neutral. Such a combination of conditions can increase the degree of pronation of the foot and/or lower leg. At toe-off, or during the propulsive phase of gait, the foot is required to be a rigid lever, and in order to be such a lever, the foot must be fully supinated. If the foot is not fully supinated at toe-off, overuse problems of the lower extremity may be encountered (23:15). Extended pronation can delay full supination of the foot and hence may be related to the shin splint syndrome. The study thusly supported the contention that abnormal pronation of the foot and/or lower leg was related to shin splints.

Likewise, the study supported the belief that transverse plane abnormalities are related to shin splints (26:77) since all measurements of femur rotation at the hip were significantly different between persons who had current shin splints and persons who never had shin splints. Transverse plane abnormalities such as increased

external and internal rotation of the femur with the hip both flexed and extended may be related to shin splints since such abnormalities may alter leg stride or foot strike (26:77) which could result in extended pronation.

The theory that the shin splint syndrome was related to sagittal plane abnormalities (26:77), i.e., tightness of the muscle groups which cause movement in the sagittal plane was based on the thought that such tightness would not allow the necessary range of movement for activity and consequently would place the leg in a stressful situation which would result perhaps in such overuse syndromes as shin splints. This theory was supported when the study found that dorsiflexion of the ankle with the knee extended was found to be slightly less in persons who had current shin splints than in persons who never had shin splints. However, findings of the study in relationship to the degrees of flexibility of the hamstring muscle group and the degree of dorsiflexion of the ankle with the knee flexed contradicted the theory that tightness of the muscles in the sagittal planes of the body is related to shin splints. In fact, the study found that persons who currently had shin splints had greater flexibility and greater ranges of motion regarding these specific movements than persons who never had the shin splint syndrome. It is hypothesized that such increases in the ranges of motion of the hamstring muscle group and the degree of dorsiflexion of the ankle with the knee flexed may

result in alteration of stride or foot strike and hence may result in the shin splint syndrome.

The study provided limited insight into the relationships between the shin splint syndrome, pronation, transverse plane abnormalities, and sagittal plane abnormalities. However, further research is required before specific relationships can be firmly established.

Although many statements have been made suggesting that persons who currently have the shin splint syndrome have different alignments of the lower extremity than persons who never had the syndrome, to the author's knowledge no specific statements have been made concerning the alignment of persons who previously had shin splints. Results of the analysis of variance and the Duncan's Test indicated the alignment of persons who previously had shin splints was significantly different from both the alignment of persons who never had shin splints and the alignment of persons who currently had shin splints. The difference between persons who previously had shin splints and persons who never had shin splints again seemed to support the contention that persons who became afflicted with shin splints have different lower extremity alignments. Perhaps the differences between persons who previously had shin splints and persons who currently had shin splints were brought about by the different conditioning programs the athletes were undergoing. The study found that the alignment of persons who previously had the shin splint syndrome was significantly different from

the alignment of persons who had never been afflicted with the syndrome. Perhaps these differences set the stage for the onset of shin splints, and the various conditioning programs and exercises aggravated the already existing conditions resulting in additional alignment differences.

To the researcher's knowledge, no investigator has studied the lower extremity alignment of the athlete as the athlete progresses through the stages of the shin splint syndrome. No researcher has yet studied the alignment to determine whether or not it remains constant, or in fact changes as the athlete: 1) begins to work out and is injury free; 2) continues to work out but becomes afflicted with the shin splint syndrome; 3) ceases to work out and is alleviated of the pain of shin splints and, 4) begins to work out and is free of the ailment. Such research is needed to explain the differences between persons who had previous shin splints and persons who had current shin splints.

Therapeutically speaking, the results of the analysis of variance and the Duncan's Test seem to suggest that if an athlete desires to function free of shin splints, then the lower extremity of that athlete should be aligned in a specific manner. The study suggests that realignment of the lower extremity of persons who previously had shin splints and persons who had current shin splints so that the alignments more nearly approximate the alignment of persons who have

never had shin splints may be helpful in treating shin splints. Such realignment has been proposed (12,18) and has in some cases been used to treat the shin splint syndrome (22:111). However, experimental research and the collection of much more data are needed before such treatment could be widely accepted.

As indicated by the results of the step-wise regression, a person who is particularly susceptible to the shin splint syndrome would be a person who had excessive:

1. external rotation of the femur with the hip extended
2. dorsiflexion of the ankle with the knee flexed
3. dorsiflexion of the ankle with the knee extended
4. inversion of the subtalar joint, and who, when standing, with the subtalar joint in the static stance position, had:
 - a) an increased varum position of the tibia, and
 - b) an increased degree of inversion of the calcaneus.

These six factors were suggested by the step-wise regression to be predictors of the shin splint syndrome, and their relationship to the syndrome may be accounted for through the theories of pronation, transverse plane abnormalities, and sagittal plane abnormalities spoken of previously. Also, the measures of hamstring flexibility and the position of the tibia with the subtalar joint neutral perhaps

should be considered when attempting to predict the shin splint syndrome as their F-values to enter were nearly significant ($p < .05$).

To the author's knowledge, no other studies have determined predictive factors for the syndrome. However, attempts have been made to describe a female athlete who is experiencing shin splints. The six factors determined by the study to be predictors of the syndrome coincided with the generally accepted descriptive statement that, within the general population, females tend to have shin splints on the medial aspect of the tibia and tend to walk to the inside of the foot in a somewhat everted (or pronated) position (5).

Of the fifteen measures taken to describe the lower extremity only six measures were indicated as predictors of the shin splint syndrome. The other measures do not seem to significantly contribute to the prediction and description of a shin splint victim. But, when considering the results of the Duncan's Test which compared persons who had never had shin splints to persons who currently had shin splints, ten of the fifteen measures taken were significantly different ($p < .05$). Thus, the study seems to present contradictory findings; ten of fifteen mean measures are significantly different, but only six of these measures are suggested as predictive factors of the shin splint syndrome. This apparent contradiction may in part be explained by the concept of the lower extremity being a linked system, i.e., a system in which any change in one part of the system will bring about

change in other parts of the system. Thus, although ten of the fifteen measures were in fact significantly different according to the Duncan's Test, the ten differences may be manifested throughout the alignment of the lower extremity, and hence the ten measures may be represented within the six measures found to be predictive factors of the shin splint syndrome according to the step-wise regression. From this analysis it appears that only six of the fifteen measures are needed to describe a population of persons who are prone to the shin splint syndrome.

Practically speaking then, persons involved with women's athletics and who desire that the athletes be able to train and perform without the hindrance of the shin splint syndrome should become aware of the six factors which describe an athlete who is susceptible to the development of the shin splint syndrome. Thus, physicians, athletic trainers, and coaches should acquaint themselves with the six predictive factors of the shin splint syndrome. Furthermore, these persons should be aware of each of the ten measures which differed between persons with shin splints and persons who never had shin splints. If the predictive factors are noted in an athlete, the coach, trainer, etc., may then consider the other important measures.

Also, if physicians, trainers, and coaches are aware of the measures which predispose a woman athlete to the shin splint syndrome, then training programs will be designed with these specific factors in

mind. Anyone designing a conditioning or training program for women would want to consider the following suggestions relative to their athletes, the shin splint syndrome, and the training program.

1. Excessive stretching of the internal rotators of the hip, and excessive strengthening of the external rotators of the hip may increase the degree of external rotation of the femur when the hip joint is extended and should be avoided. Although some degree of external rotation is desirable, and in fact necessary for normal ambulation, excessive increases in external rotation should be avoided since it seems to be related to the occurrence of shin splints.

The degree of external rotation of the femur may be controlled and/or reduced by strengthening the internal rotators of the hip consequently stretching the external rotators. As the internal rotators become stronger, they will limit the degree of external rotation possible, and so may decrease the possibility of shin splints occurring.

2. Excessive stretching of the plantarflexors of the foot and/or excessive strengthening of the dorsiflexors of the foot should be avoided. Such stretching and/or strengthening of these muscle groups may increase the degree of dorsiflexion at the ankle joint, and, since increasing degrees of dorsiflexion at the ankle joint is related to shin splints, may increase the possibility of shin splints occurring. The degree of dorsiflexion at the ankle may be controlled and/or reduced through strengthening of the plantarflexors and

stretching of the dorsiflexors. As the plantarflexors become stronger they may help control the degree of dorsiflexion and consequently may decrease the possibility of shin splints occurring.

Likewise, trainers should consider the fact that the prevention of the shin splint syndrome may be possible by decreasing: 1) the degree of varum present at the tibia with the subtalar joint static; 2) the degree of inversion present at the subtalar joint, and 3) the degree of inversion of the calcaneus when the subtalar joint is static. Such adjustments in the alignment of the lower extremity may be accomplished through the use of proper footwear, proper strapping techniques and/or the use of orthotics.

Although the above considerations are indicated by the study, further investigation is required before firm, exacting conclusions can be drawn and suggestions made.

Chapter 6

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

A study was conducted to investigate the relationships between lower extremity alignments and the shin splint syndrome in female athletes. Selected measures describing the alignment of the lower extremities of 32 women athletes were taken. Data recorded were classified into five groups: Group 1 - No shin splints; Group 2 - Current moderate shin splints; Group 3 - Current severe shin splints; Group 4 - Previous shin splints; and Group 5 - Current shin splints. Data were analyzed through the use of an analysis of variance, a Duncan's Test, and a step-wise regression.

The analysis of variance found that there were significant alignment differences ($p < .05$) between subjects who had no shin splints, subjects who had shin splints previously, and subjects who currently had shin splints.

The Duncan's Test indicated the variables which were significantly different ($p < .05$) between each of the above-mentioned groups. Ten of the fifteen measures varied significantly between the no shin splint group and the current shin splint group and between the no shin splint group and the previous shin splint group. Eleven of the fifteen measures varied significantly between the previous shin splint group and the current shin splint group.

The step-wise regression indicated that six of the fifteen measurements taken could be used to predict the occurrence of shin splints on the medial side of the tibia. These six factors included in descending order of importance: the degree of external rotation of the femur/hip extended, the degree of dorsiflexion at the ankle joint/knee flexed, the degree of inversion at the subtalar joint, the frontal plane position of the tibia/subtalar joint static, the degree of dorsiflexion at the ankle joint/knee extended, and the position of the calcaneus in relationship to the floor/subtalar joint static.

Conclusions

The study has opened a new door of thought regarding the shin splint syndrome, its occurrence, and its treatment. The study found that it was possible to describe three specific populations according to the alignment of the lower extremity as defined by fifteen measures. It also found that certain alignments of the lower extremity were significantly related to the shin splint syndrome and hence it should be possible to predict the occurrence of the syndrome with the knowledge of certain specific measures. The study even suggested that realignment of the lower extremity may prevent or cure the shin splint syndrome.

Recommendations

Further investigation into the relationships between the shin splint syndrome and the alignment of the lower extremity is needed before the sports world can accept and begin to use the theories proposed in the study. Suggestions for further investigation include:

1. the conduction of studies which explore the relationship of the alignment of the lower extremity of male athletes and the occurrence of the shin splint syndrome.

2. the conduction of studies which explore the relationship of lower extremity alignment and the occurrence of the shin splint syndrome on the lateral aspect of the tibia for both male and female athletes.

3. the conduction of studies which would explore the relationship between lower leg alignment, occurrence of the shin splint syndrome, and participation in specific sports, or specific types of sports activities.

4. the conduction of well controlled experimental studies to determine the effects of the use of realignment of the lower extremity as a method to treat or prevent the shin splint syndrome.

5. the conduction of a more thorough study of the torsional pathologies of the hip, and their relationships to the shin splint syndrome.

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APPENDICES

APPENDIX A

LEFT		RIGHT		SUBTALAR JOINT:	
☐	☐	INVERSION	☐	☐	SUPINATION
☐	☐	EVERSION	☐	☐	PROMOTION
☐	☐		☐	☐	TOTAL R.O.M.
☐	☐	VARUS	☐	☐	NEUTRAL POSITION
☐	☐	VALGUS	☐	☐	

5 = NORMAL
 4 = GOOD
 3 = FAIR
 2 = POOR
 1 = TRACE
 0 = ZERO

0		VARUS		0	<u>MIDTARSAL JOINT:</u>
		VALGUS			

EVALUATION:

		DORSIFLEXION		
		PLANTARFLEXION		

FIRST RAY:

O	DORSIFLEXION	O
	PLANTARFLEXION	
O	DORSIFLEXION	O
	PLANTARFLEXION	

ANKLE JOINT:

	O	INTERNAL		O
		EXTERNAL		
	O	INTERNAL		O
		EXTERNAL		

ANKLE TO KNEE:

Σ HIP		Σ HIP	
EXTENDED	FLEXED	EXTENDED	FLEXED
☐	☐	☐	☐
☐	☐	☐	☐
☐	☐	☐	☐
☐	☐	☐	☐

HIP JOINT:

VARUM	VALGUM	RECTUR VATUM	VARUM	VALGUM	RECTUR VATUM
0	0	0	0	0	0

GENU DEVIATION:

T.M. DISTANCE	cm.
---------------	-----

O		ADDUCTION		O
		ABDUCTION		
O		VARUS		O
		VALGUS		
O		VARUS		O
		VALGUS		
O		INVERTED		O
		EVERTED		
O		INVERTED		O
		EVERTED		
O		PRONATION		O
		SUPINATION		

STANCE CORRELATION:

ANGLE OF GAIT

FRONTAL PLANE POSITION OF TIBIA
C SUBTALAR JT. STATIC POSITION

FRONTAL PLANE POSITION OF
TIBIA C SUBTALAR JT. NEUTRAL

CALCANEAL POSITION TO FLOOR
C SUBTALAR JOINT NEUTRAL

CALCANEAL STANCE POSITION IN
STATIC ANGLE OF GAIT

RESULTANT: ABNORMAL
SUBTALAR JOINT POSITION

LEFT		RIGHT	
HIP:	FLEXORS	}	ILIOPSOAS
	EXTENSORS		GLUT. MAX., HAM5
	ABDUCTORS	}	GLUT. MED & MIN.
	ADDUCTOR GROUP		
	EXT. ROTATOR GROUP		
	INT. ROTATORS	}	GLUT. MIN. T.F.L.
	SARTORIUS		
KNEE:	FLEXORS	}	HAMS
	EXTENSORS		QUAD FEM. GROUP
ANKLE:	DORSIFLEXORS	}	E.D.L., E.H.L. ANT. TIB.
	PLANTARFLEXORS		GASTROCNEMIUS SOLEUS
FOOT:	SUPINATORS	}	TIB. ANT. TIB. POST.
	PROMOTOR		PER. GR.

COMMENTS, CONCLUSIONS, or GAIT ANALYSIS

APPENDIX B

SUBJECT SELECTION INTERVIEW

Name _____ Height _____
Phone _____ Weight _____
Occupation _____ Curriculum _____ Year _____
Age _____ Sex _____ Race _____

Do you run/jog on a regular basis? _____
if so: How far _____
Type of surface _____
Brand of shoe _____
How long have you been doing this? _____

Other activities engaged in presently? _____

Past activities:

Were you an athlete previously? _____ Yes _____ No
if so: What sports? _____ Basketball _____

_____ Track/Field _____

_____ Volleyball _____

_____ Others _____

Have you been under serious workout procedures other than in a
situation as above? _____ Yes _____ No

if so: When _____
Type of activity _____

Shin Splints:

Have you EVER experienced shin splints? _____ Yes _____ No
if so: When _____ if presently: Diagnosed by trainer _____ Yes
What activity were you doing at the time? _____

Where did the pain become noticeable? _____

Which leg(s) was affected? _____ Right _____ Left _____ Both

Other injuries: Sprained ankles _____ Right _____ Left _____ Both
Knee injuries _____ Right _____ Left _____ Both
Others: _____

Subjected selected: _____ Yes _____ No
Legs Measurable: _____ Right _____ Left _____ Both
Group assigned: _____ 1 - Has never experienced shin splints, but has
been active.
_____ 2 - Previously experienced shin splints, but is
not afflicted with them now.
_____ 3 - Is presently afflicted with shin splints as
diagnosed by trainer Chuck Karnop (Montana
State University)

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N378 Lilletvedt, Janice M
 L628 Descriptive analysis
 cop.2 of selected alignment
 factors of the lower
 extremity ...

DATE	ISSUED TO
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	<i>Annex 2 Copy</i>
	<i>101 R</i>
	<i>Adm. G. Court</i>
	<i>AUG 12 '77</i>
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OCT 6	<i>1977/kykr</i>
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