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The effect of the Anderson Knee Stabler on various components of knee function : a thesis ...

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THE EFFECT OF THE ANDERSON KNEE STABLER ON VARIOUS COMPONENTS OF KNEE FUNCTION

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by

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CHAPTER I

Introduction

The use of knee braces in the past has been to protect and prevent further injury to a previously damaged knee. An example of one such knee brace is the Lennox-Hill Derotation knee brace. This brace is used to assist the athlete who has a rotary knee instability from a previous injury. (Klafs and Arnheim, 1977.)

Recently, knee braces are being designed to prevent knee injuries in normal healthy athletes. The first such brace, the Anderson Knee Stabler, was designed by George Anderson, the head trainer of the Los Angeles Raiders. Omni Scientific (1981) described the brace as a double-hinged single sided brace with a center support bar. The center of the center support bar is lined up directly opposite the lateral joint line of the knee. The center support bar is made of lightweight steel which absorbs the force of a lateral blow which could potentially traumatize the knee joint, specifically a medial collateral ligament and the medial joint capsule. The brace will also protect the lateral side of the knee from possible contusions and their resulting hematomas.

The brace is designed specifically for football players who are subjected to the injurious lateral forces with much greater degrees of frequency than other athletes. No brace has received such acclaim and widespread usage as the Anderson Knee Stabler as a means for injury prevention to the knee in the football setting. Several professional and collegiate teams require many of their players to wear the brace. The specific players who most frequently wear the brace are the offensive lineman and other players who have sustained a previous knee injury to the medial collateral ligament.

However, very little attention has been paid to the potential effect of the Anderson Knee Stabler on the individual's knee and leg function. This study is designed specifically to detail to what extent, if any, the individual athlete is being impaired by the Anderson Knee Stabler.

Statement of the Problem

The problem of this study is to determine the possible effects of the Anderson Knee Stabler on mean isometric torque output in the knee extensors, mean isokinetic torque output at several speeds in the knee extensors and performance on the SEMO Agility Test in college football players.

Subproblems

1. Is there a significant difference between the braced and the unbraced knee upon the production of

isometric torque in the knee extensors of the dominant leg?

2. Is there a significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 30° per second in the knee extensors of the dominant leg?

3. Is there a significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 90° per second in the knee extensors of the dominant leg?

4. Is there a significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 180° per second in the knee extensors of the dominant leg?

5. Is there a significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 300° per second in the knee extensors of the dominant leg?

6. Is there a significant difference between the braced and the unbraced knees upon performance on the SEMO Agility Test?

Importance of the Study

This study is important because it will assess the functional capability of an athlete wearing this given brace. Also, if significant differences are not achieved it will serve as a means of promoting this brace to those who may be reluctant to use it. If significant results are achieved then athletic trainers and coaches may have to rethink whether this brace is impairing the performance of their athletes.

Delimitations of the Study

This study was delimited to the following:

1. Each football player attended the University of the Pacific as a full time student during the 1983-1984 academic year.

2. Each football player was an offensive center, guard or tackle on the University of the Pacific varsity football team. Only these athletes were considered because of a coaching staff requirement to wear the braces as a preventative against knee injury.

3. Each subject had prior experience with the Anderson Knee Stabler. This means they had worn the brace previously in a game or practice situation.

4. Each subject had not sustained a serious knee injury within the last year, and has never sustained a knee injury requiring surgery to the dominant leg.

5. Based on the nature of the study only the dominant leg will be considered for isokinetic and isometric testing.

6. All subjects were male.

Limitation

When this study was originally undertaken the sample size was to be eight. During the course of this study two subjects were eliminated. The first subject contracted acute strep throat which had required him to be confined to bed rest for several days. The second subject to be eliminated injured his dominant knee running during his conditioning program. The injury was believed to be serious enough to discontinue his further participation in this study. The final data collecting sample was then reduced to six.

Statement of Working Hypotheses

Based upon the review of the literature, coach and athlete input, and information from many athletic trainers, the following working hypotheses were developed:

1. There will be no significant difference between the braced and the unbraced knee upon the production of isometric torque in the knee extensors of the dominant leg. The reason for this would be based upon the fact that the knee joint is not moving; therefore, the brace in question should not affect torque output.

2. There will be no significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 30° per second and 90° per second in the knee extensors of the dominant leg. The two speeds are relatively slow and controlled. The brace should have very little, if any, effect on torque produced at these two speeds.

3. There will be a significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 180° per second and 300° per second. These two speeds are much faster, whereby creating a need for the knee extensors to forcefully contract and move at a greater speed than at the lesser degrees. Also, these two speeds are very functional, that is, they are representative of speeds used in the sport of football. I feel that this is where the brace may have an inhibiting effect.

4. There will be a significant difference between the braced and the unbraced knees upon performance on the SEMO Agility Test. This simple agility test requires the athlete to move forward, backward and side to side, simulating the movements required of an offensive lineman. This is the crux of the issue. If the Anderson Knee Stabler does in fact significantly alter function in this type of test, then practitioners and clinicians in injury prevention in athletes may need to re-examine the use of this particular brace as a preventative measure on healthy athletes.

Assumptions

This study was based on the following assumptions:

1. It was assumed that each subject is giving maximum effort in each phase of testing.

2. It was assumed that fatigue will not be a factor in this study because of the short duration of each

phase of testing.

3. It was assumed that learning will not be a factor in any phase of the study.

Definition of Terms

The following terms are defined in order to facilitate a better understanding of this study:

Torque - Torque is a force which acts about an axis of rotation. It is the product of this force times its perpendicular distance from the axis of rotation. (Moffroid et al, 1969.)

Isokinetic Contraction - An isokinetic contraction is a dynamic type of resistive exercise with two unique features. The angular velocity of an isokinetic exercise device can be specified. Second, when a specified velocity is reached, the device automatically accommodates to give maximal resistance at each point in the range of motion while allowing the specified velocity to be maintained. (Wyatt and Edwards, 1981.)

Isometric Contraction - An isometric contraction is when a muscle develops tension which is insufficient to move a body part against a given resistance, and the length of the muscle remains unchanged. (Rasch and Burke, 1978.)

Agility - Agility may be defined as the physical ability which enables an individual to rapidly change body position and direction in a precise manner. (Johnson and Nelson, 1979.)

Anderson Knee Stabler - The Anderson Knee Stabler is a single-sided, double hinged knee brace which provides the knee protection from lateral forces which may cause potential damage to the ligamentous structure of the knee. For this study, the Anderson Knee Stabler Model 101W will be used. Its unique feature is that it is secured to the leg with neoprene sleeves superior and inferior to the knee. (Omni Scientific, 1981.)

Braced Knee - The braced knee is defined as the dominant leg of the athlete undergoing testing, in which the knee has been outfitted with the Anderson Knee Stabler.

Unbraced Knee - The unbraced knee is defined as the dominant leg of the athlete undergoing testing, without the Anderson Knee Stabler.

Dominant Leg - The dominant leg is defined as the leg which the athlete prefers to use when kicking a football.

Cybex II Dynamometer - The Cybex II Dynamometer is a machine which allows one to exercise a limb isometrically or isokinetically; in this case, the knee extensors of the dominant leg. The apparatus is equipped with a recorder which allows one to accurately measure the torque produced during an isokinetic or isometric contraction. (Lumex Inc., 1982.)

CHAPTER II

Review of the Related Literature

Research demonstrating the effect of preventative knee bracing on performance is scarce. This is due to the fact that preventative bracing is such a relatively new area of exploration. However, the following research articles are reviewed to aid in the understanding of the effect of several preventative measures on various performance criteria.

Strapping and Taping of the Ankle

Mayhew (1972) studied the effect of preventative ankle taping on physical education majors (n=66). The researcher utilized four motor performance tests to evaluate whether preventative ankle taping inhibited performance. The test battery included: (a) 50 yard dash, (b) standing vertical jump, (c) standing broad jump, and (d) the Illinois Agility Run. The ankle taping used was the standard closed Gibney or basketweave as indicated by Klafs and Arnheim (1963).

A paired t-test was used to determine if any significant differences existed between the taped and the untaped performances on each of the four motor performance tests. Differences were considered significant at the .05 level.

The results indicated that performance on the vertical jump and the standing broad jump were significantly impaired by preventative ankle taping. The t-scores were 4.05 and 2.76 respectively. Performance on the 50 yard dash and the Illinois Agility Run was not significantly impaired. The t-scores were -1.76 and -0.87 respectively.

The researcher concluded that preventative ankle taping reduced performance in those activities that depend largely on plantar flexion of the foot. Also, the researcher concluded that differences in motor performance were small and may not be great enough to impair actual sports participation.

Juvenal (1972) studied the effect of two preventative ankle taping techniques on vertical jumping ability of male physical education majors (n=30). The subjects were tested under three conditions: no tape, linen tape, and elastic tape. Each testing session consisted of five running vertical jumps with the highest and the lowest of the five jumps not scored in order to minimize the effects of learning. Heights achieved were measured from the individual's highest flat footed reach on the wall board.

A block designed analysis of variance was used to determine significant differences between the height jumped under each of three conditions. Differences were considered significant at the .05 level.

The results showed that the height achieved with no tape was significantly greater than the height achieved with linen or elastic tape. It was further determined that the height jumped with elastic tape was significantly greater than with linen tape.

The researcher concluded that preventative ankle taping did significantly impair jumping ability. However, no injuries occurred during the course of the study. This brings up an important point: Which is more important, injury prevention or increased performance?

Abdenour et al (1979) studied the effect of preventative ankle taping upon torque and range of motion in male subjects (n=7). The data was collected using a Cybex II isokinetic dynamometer with dual channel recorder at a slow speed (30° per second) and a fast speed (120° per second). Range of motion was also measured with the Cybex.

The data was analyzed using the Mann-Whitney U test for small samples. Values were considered significant at the .05 level.

The results indicate that torque production and range of motion of all ankle movements (plantar flexion, dorsiflexion, inversion and eversion) were not significantly affected by preventative ankle taping at the slow speed (30° per second). Inversion range of motion at the fast speed (120° per second) was significantly altered by preventative ankle taping, while range of motion at the other three movements was not significantly impaired. Torque production at the fast speed (120° per second) did not significantly change in any of the four ankle movements when preventative ankle taping was applied.

Knee Bracing

Nwaobi (1980) studied the effect of bracing, elastic tape, and non-elastic tape on medial stability of the knee in male athletes (n=20). The subjects were measured for lateral deviation of the tibia on the femur, before and after the application of a hinged metal brace, elastic tape and non-elastic tape, and again after a ten minute period of continuous exercise.

The results showed that all supports significantly reduced lateral deviation before activity at the .05 level. Elastic tape did not significantly decrease lateral deviation after activity at the .05 level. The brace and the non-elastic tape did significantly decrease lateral deviation after activity at the .05 level.

After activity the elastic lost 39.6% of its effectiveness, the non-elastic tape lost 38.7% of its effectiveness, and the hinged metal brace lost 17.6% of its effectiveness.

The researcher concluded that these results demonstrate the effectiveness of frequently used hinged metal supports in reducing lateral deviation of the knee before and after a period of continuous exercise.

Houston and Goemans (1982) studied the effect of prescribed knee support braces on male athletes at the

University of Waterloo (n=7). The Cybex II isokinetic dynamometer was used to assess each subject's mean isometric torque (0^{o} per second) at 90^{o} of knee flexion. Mean isokinetic torque was measured at 30^{o} per second, 90^{o} per second, 180^{o} per second, and 300^{o} per second. Only the knee extensors (quadriceps femoris) were tested. The subjects were tested with and without their prescribed braces. Vertical Velocity (power) was measured using a short stair run. Blood lactate concentration was measured before and after a fifteen minute endurance ride.

Significant differences between the braced and the unbraced condition were assessed using a matched pair t test. Differences were deemed significant at the .05 and the .01 level.

The results indicated that there were no significant differences in mean isometric torque output at the .05 level. Mean dynamic torque output at the four testing velocities was significantly improved in the no brace condition. The mean differences between the two conditions increased with knee extension velocity ranging from 12% at 30^{o} per second to 30% at 300^{o} per second.

Performance on the short stair run without the prescribed knee supports was significantly improved, whether measured as vertical velocity or power output. Blood lactate concentrations after exercise were 41% higher when the subjects were wearing their prescribed knee supports. This was significant at the .01 level.

The researchers concluded that these results demonstrate that the potential benefits of support braces for knee instability come at the expense of impaired performance.

In summary, these studies show that preventative ankle taping and knee bracing do have a detrimental effect on certain aspects of performance. However, it remains unclear as to the effect of preventative knee bracing on performance. This study will demonstrate whether this preventative knee bracing does in fact hinder performance.

CHAPTER III

Research Methodology

The purpose of this study was to determine if mean isometric torque output, mean isokinetic torque output at several speeds, and performance on the SEMO Agility Test were significantly altered by use of the Anderson Knee Stabler on the dominant legs of college football players.

The Sources of the Data

The sources of the data for this study were six male varsity college football players who attended the University of the Pacific. The six athletes selected were offensive linemen who played either center, guard or tackle. Their mean height was 76.5 inches, ranging from 74 inches to 79 inches. Their mean weight was 253 pounds, ranging from 220 pounds to 277 pounds. The average age was 20.8 years, ranging from 20 to 22 years old. All subjects preferred their right leg as the dominant leg.

Data Collecting Instrument

The Cybex II isokinetic dynamometer with dual channel recorder was utilized to quantify mean isometric and mean isokinetic torque outputs at several speeds of the knee extensors of the dominant leg in the braced and the unbraced conditions. The machine was calibrated before each testing session in accordance to the protocol established by the Lumex Corporation, manufacturers of the Cybex II. Moffroid et al (1969) used a test-retest reliability procedure to establish a reliability co-efficient of r=0.995. The co-efficient of validity was found to be r=0.999.

The SEMO Agility Test was used to assess general agility in the braced and the unbraced conditions. The reliability of this test was found to be r=0.88 when the best of two trials are used. A validity co-efficient of r=0.63 was found when the SEMO Agility Test was correlated with the AAHPER Shuttle Run Test. A digital stopwatch was used to time the subjects during the agility test. (Johnson and Nelson, 1979.)

Procedures for Data Collection

Eight offensive linemen on the University of the Pacific varsity football team were approached about participating in this study. Each subject volunteered and met the criterion established in regards to the status of their knees.

The subjects were then acquainted with the testing procedures. The first day of testing consisted of isometric and isokinetic evaluations without the knee brace. Each subject came to the testing location and was familiarized with the Cybex II. Care was taken to make sure the machinery was calibrated beforehand, and that the apparatus was properly set up for each subject. The axis of rotation of the dynamometer was aligned directly opposite the lateral femoral condyle of the dominant knee. The shin strap was securely strapped proximal to the maleoli of the ankle. The thigh strap was secured at mid-thigh to prevent upward movement of the thigh. The knee was allowed a minimum of 90° of flexion and could be extended to each individual's endpoint of the range.

Once the subject was securely in place he was given the following instructions:

1. You will be allowed to warm-up at each testing velocity. (As suggested by Johnson and Siegel, 1982.)

2. Perform each extension with maximal torque. This is done to achieve maximal torque per extension.

3. When you complete each extension, allow the leg to relax back to its initial starting position.

4. Three forceful complete extensions of the knee are to be done at each speed.

After a light warm-up at 120° per second to familiarize the subject with the machines, three trials were observed at each speed: 0° per second at 90° of knee flexion, 30° per second, 90° per second, 180° per second and 300° per second. At each speed, the subject was allowed to acquaint himself with the velocity until he was comfortable. A short rest period was also observed between each trial.

Mean isometric output was the average of the three trials at 0° per second with 90° of knee flexion. Mean isokinetic torque output was the average of the three trials at 30° per second, 90° per second, 180° per second and 300° per second.

After the initial day of testing one subject contracted strep throat and could not further participate in the study.

Two days later the subjects reported to the gym at their assigned times for baseline agility testing without the knee brace. The SEMO Agility Test is designed to measure the general agility of the body as it maneuvers forward, backward and side to side. A diagram of the SEMO Agility Test is in Figure 1.

A stopwatch was used to measure the time it took to complete the circuit. A cross-over step did not constitute a side step, and was deemed an unscored trial. The subjects were given as many warm-ups, sub-maximal and maximal, as needed to insure that the athlete was familiar with the circuit. This was done to minimize the effects of learning.

The best of two scored trials was to be the performance score of the baseline agility testing.

A second subject was eliminated with an injury to his dominant knee during conditioning drills. Five days after the initial baseline Cybex II evaluation without the Anderson Knee Stabler, the subjects reported back for the

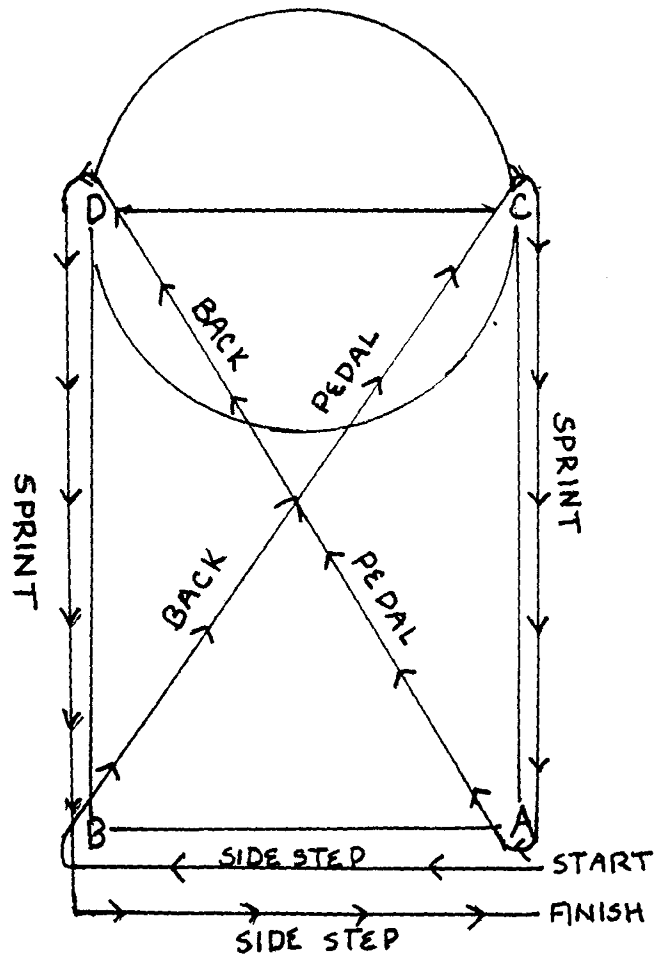


FIGURE 1

SEMO Agility Test

Cybex II evaluation with the Anderson Knee Stabler on. The brace was a Model #101W. This particular variation uses two neoprene sleeves that attach proximally and distally to the knee joint, to hold the brace in place. Care was taken to align the middle of the center bar of the brace with the lateral joint line. The subjects were given the same instructions and tested under the same procedure as in the baseline testing condition.

Again, mean isometric torque output with the knee brace in place was the average of the three trials at 0° per second at 90° of knee flexion. Mean isokinetic torque output with the knee brace in place was the average of the three trials at each speed, 30° per second, 90° per second, 180° per second and 300° per second.

Five days after the baseline agility testing the subjects were to run the SEMO Agility Test with both knees braced. Care was taken to equalize the testing conditions. The subjects wore the same pair of tennis shoes during the braced and the unbraced testing. The same location was used during both testing conditions; consequently the same surface was used. Again the subjects were allowed to take as many warm-up trials as needed to familiarize themselves with the course. The best of two trials was the general agility score with the braces in place.

Analysis of the Data

The data were analyzed using a student's t-test for small samples. A one tailed test was utilized to determine significance at the .05 level. A t-value greater than 1.812 with 10 degrees of freedom was needed to reject the null hypotheses, whereby finding that the Anderson Knee Stabler does significantly impair function under the conditions of the specific test.

CHAPTER IV

Results and Discussion

The raw data collected during the course of this study can be found in Appendices A and B. These graphs contain each individual's mean peak torque during the isometric and isokinetic evaluation with and without the knee brace. The scored trials for the SEMO Agility Test with and without the knee brace can also be found in these appendices.

Results

The results from this study showed that there was no significant difference between the braced and the unbraced conditions upon the production of isometric torque (0^{o} per second). The average for all trials without the knee brace was 176.83 foot pounds (ft. lbs.) of torque. The average for all trials with the knee brace was 187.22 ft. lbs. of torque. This 10.39 ft. lb. increase amounted to a 5.8% increase in torque production when the brace was worn and a t-score of -0.642. (See Table 1.) Differences were deemed significant at the .05 level. A t-score greater than 1.812 was needed to show significant differences.

The results also showed that there was no significant difference between the braced and the unbraced

TABLE 1

ISOMETRIC TORQUE OUTPUT

Mean Peak Torque, Standard Deviations
and Pooled Estimator of Standard Deviation
for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
0°/s	176.83	27.10	187.22	33.01	30.20	-0.642

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

conditions upon production of torque at 30° per second. The average for all trials with the knee brace was 191.00 ft. lbs. of torque. This two foot pound difference was a 1.1% increase in overall torque production when the knee brace was worn and a t-score of -0.117 (Table 2).

The results showed that there was no significant difference between the braced and the unbraced conditions upon production of torque at 90° per second. The average of all trials without the brace was 157.11 ft. lbs. of torque. The average of all trials with the brace was 162.78 ft. lbs. of torque. This 5.67 difference in ft. lbs. of torque amounted to a 3.6% increase in torque production when the knee brace was worn and a t-score of -0.544 (Table 3).

The results also showed that there was no significant difference between the braced and the unbraced conditions upon production of torque at 180° per second. The average of all trials without the brace was 127.23 ft. lbs. of torque. The average of all trials with the brace was 132.78 ft. lbs. of torque. This 5.55 difference amounts to a 4.4% increase in torque production when the knee brace was worn and a t-score of -0.905 (Table 4).

The results at 300° per second were very different. Although not significant, there was a rather sharp decrease in torque production when the knee brace was worn. The average of all trials without the knee brace was 111.44 ft. lbs. of torque. The average of all trials with the knee brace was 105.33 ft. lbs. of torque. This 6.11 ft. lb.

TABLE 2

30° PER SECOND

Mean Peak Torque, Standard Deviations
and Pooled Estimator of Standard Deviation
for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
30°/s	189.00	35.042	191.00	27.752	29.543	-0.117

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

TABLE 3

90^{o} PER SECOND

Mean Peak Torque, Standard Deviations, and Pooled Estimator of Standard Deviation for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
90^{o}/s	157.11	14.233	162.78	12.176	18.042	-0.544

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

TABLE 4

180° PER SECOND

Mean Peak Torque, Standard Deviations and Pooled Estimator of Standard Deviation for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
180°/s	127.23	13.134	132.78	7.298	10.645	-0.905

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

difference amounted to a 5.5% decrease in torque production when the knee brace was worn and a t-score of 1.0065 (Table 5).

The results of the SEMO Agility Test showed that there was a small decrease in performance. This decrease was, however, not significant. The average of all scored trials without the braces was 11.67 seconds. The average of all scored trials with the braces was 11.70 seconds. The difference between the two means was only three one-hundredths of a second which amounted to a mere .02% decrease in performance when the knee braces were worn and a t-score of 0.703 (Table 6).

The results showed a slight increase in torque production in both conditions, braced and no brace, between 0° per second and 30° per second. In the no brace condition a 6.2% increase in torque production was observed. Likewise, a 1% increase in torque production was observed during the braced condition. This can be attributed to the fact that during the isometric contraction (0° per second), 90° of knee flexion was not the strongest point in the range of motion. That point where maximum mean peak isometric torque can be achieved lies somewhere between 45° and 90° of knee flexion (see Figure 2).

Also, a sharp decrease in torque production was exhibited in both the braced and the no brace condition, between 30° per second and 300° per second. In the no brace condition, mean peak torque decreased 59% and during

TABLE 5

300° PER SECOND

Mean Peak Torque, Standard Deviations
and Pooled Estimator of Standard Deviation
for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
300°/s	111.44	10.832	105.33	10.187	10.515	1.0065

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

TABLE 6

SEMO AGILITY TEST

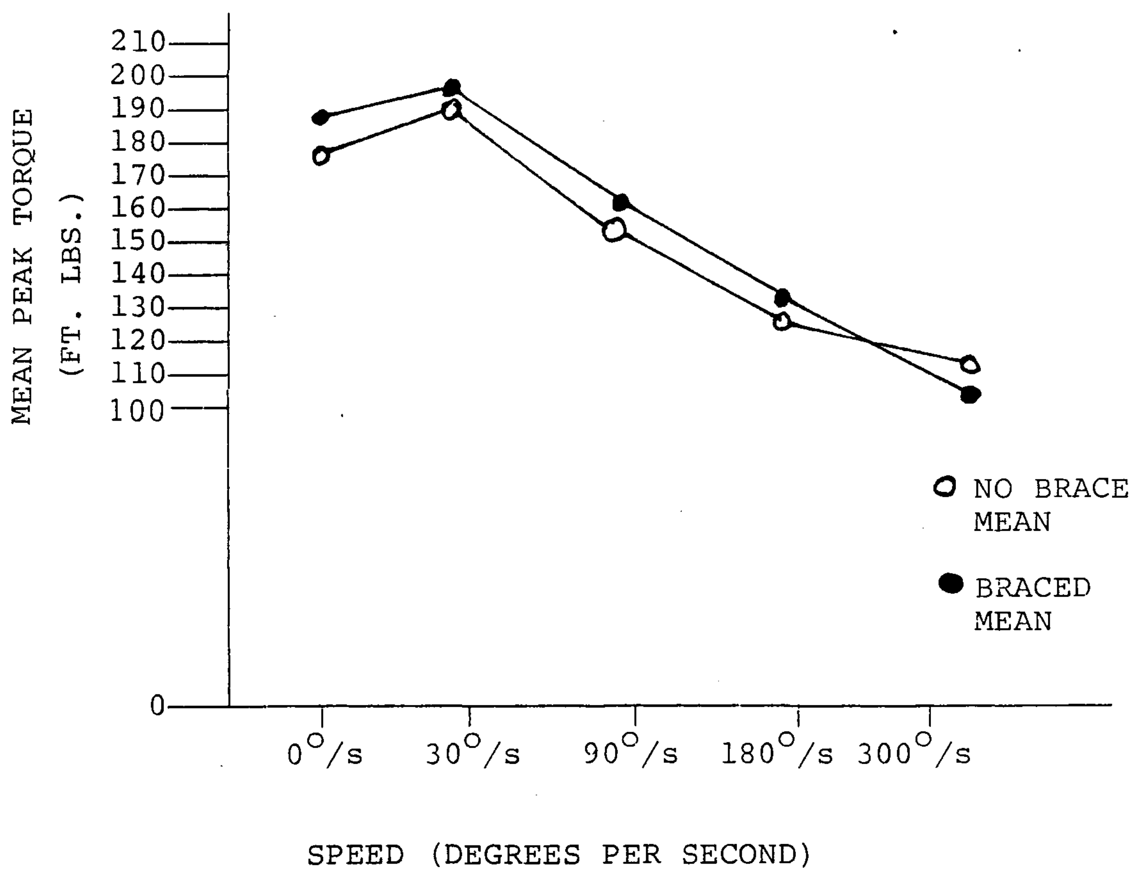
Mean Agility Scores, Standard Deviations and Pooled Estimator of Standard Deviation for the Braced and the No Brace Conditions

	NO BRACE		BRACED			
	Mean	Standard Deviation	Mean	Standard Deviation	Pooled Estimator of Standard Deviation	t score
SEMO	11.67	0.775	11.70	0.647	0.714	0.073

The t-ratio required for 10 degrees of freedom at the .05 level was 1.812

FIGURE 2

Mean Peak Torque Values at Each Testing Speed of Subjects During the Braced and the No Brace Conditions



the braced condition, mean peak torque decreased 55%. These expected decreases show that when the speed of isokinetic exercise increases, one's ability to produce isokinetic torque decreases.

Discussion

The results from this study definitely indicate that the Anderson Knee Stabler had no inhibiting effects on the performance criterion examined. The increases in mean isometric torque production (0° per second) and mean isokinetic torque production at 30° per second, 90° per second and 180° per second which were observed are secondary to the fact that the data demonstrated that the brace did not decrease torque production.

However, it is interesting that torque production increased with the application of the Anderson Knee Stabler. This phenomenon could be attributed to several factors or the interaction of several factors. First, the size of the sample was relatively small, which may have weighted the results toward one side. Second, several subjects were unfamiliar with the Cybex II apparatus. Since the subjects were tested without the brace first, the scores may have been a little low. Then when tested with the brace, the subjects may have been a little more comfortable with the Cybex II apparatus, hence achieving greater torque production. This factor, if true, would refute earlier evidence by Johnson and Siegel (1982) which states that if warm-up trials are observed, Cybex scores become normalized.

It is not believed that these two factors are of any great circumstance. They merely serve as a possible explanation for the small increases in torque production. It is not realistic to believe that the Anderson Knee Stabler will increase torque production at these given speeds with great consistency.

Perhaps the two most important occurrences in this study were that isokinetic torque production at 300° per second and performance on the SEMO Agility Test were not significantly altered when the brace was applied. The fast speed of contraction at 300° per second is considered to be of a functional nature. That is, similar to that of sprinting. This may explain why a small decrease in torque production was observed.

Performance on the SEMO Agility Test remained virtually unaffected. This is important because this test was very functional for offensive linemen. It required the subjects to maneuver around cones forward, backward, and side to side, which are very important movements for offensive linemen to perform quickly. The fact that the brace had no effect on their performance of this task is the basis for usage of the brace as a preventative measure.

The results attained from this study are in direct contrast to those achieved by Houston and Goemans (1982). However, there are two major differences between these two studies. First, the subjects chosen for participation were entirely different. This study utilized healthy subjects with no recent history of knee trauma, whereas Houston and Goemans chose subjects who had already traumatized their knees. Secondly, the braces chosen for testing were entirely different. This study chose the Anderson Knee Stabler, which is a brace primarily used for the prevention of knee injuries, whereas Houston and Goemans chose physician-prescribed knee braces which were used to support the subjects' specific instabilities. In all, three different braces were used in the Houston and Goemans study. This, indeed, may account for the different results achieved in this study.

CHAPTER V

Summary, Conclusions and Recommendations

Summary

The problem of this study was to determine the possible effects of the Anderson Knee Stabler on mean isometric torque output in the knee extensors, mean isokinetic torque output at several speeds in the knee extensors and performance on the SEMO Agility Test in college football players.

The following null hypotheses were established, tested and analyzed as follows:

1. There will be no significant difference between the braced and the unbraced knee upon the production of isometric torque in the knee extensors of the dominant leg.
2. There will be no significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 30° per second in the knee extensors of the dominant leg.
3. There will be no significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 90° per second in the knee extensors of the dominant leg.
4. There will be no significant difference between

the braced and the unbraced knee upon the production of isokinetic torque at 180° per second in the knee extensors of the dominant leg.

5. There will be no significant difference between the braced and the unbraced knee upon the production of isokinetic torque at 300° per second in the knee extensors of the dominant leg.

6. There will be no significant difference between the braced and the unbraced knees upon performance on the SEMO Agility Test.

The subjects for this study were male college varsity football players who attended the University of the Pacific (n=6). All subjects were offensive linemen who prefer their right leg as their dominant limb.

The instrument for isokinetic and isometric data collection under the braced and unbraced conditions was the Cybex II isokinetic dynamometer with dual channel recorder. The instrument used to collect data as to general agility during the braced and unbraced conditions was the SEMO Agility Test.

The data was analyzed using a Student's t-test for small samples. Significant differences were considered at the .05 level.

The primary results indicate that there was no significant difference in mean peak torque production between the braced and the unbraced conditions at 0° per second, 30° per second, 90° per second, 180° per second, and 300° per second. Likewise, no significant difference was found between the braced and the unbraced knees upon performance of the SEMO Agility Test. Torque values increased when the brace was worn: 5.8% at 0° per second, 1.1% at 30° per second, 3.6% at 90° per second, and 4.4% at 180° per second. Torque values decreased 5.5% at 300° per second.

Conclusions

Based upon the results from this study, the following conclusions were formed:

1. The Anderson Knee Stabler had virtually no effect on the performance during the assigned tasks of this study.
2. The Anderson Knee Stabler may be a viable and effective means of preventing the knee from potential injury.

Recommendations

Based upon the findings from this study, the researcher makes the following recommendations:

1. It is recommended that this study be undertaken using a larger population incorporating football players of a variety of skill levels. A study which utilizes professional, college and high school level football players would definitely be more conclusive than a study of the size herein described. The study should focus on offensive

and defensive linemen as its subjects, and should shy away from athletes who have had previously damaged knees. Endurance and power components should also be examined under the braced condition, as previously done by Houston and Goemans (1982). Lastly, the new study should incorporate internal and external tibial rotation, in addition to knee flexion and extension as measured by the Cybex II system. This type of study would most certainly show the effects of the Anderson Knee Stabler on performance.

2. This study has demonstrated that the Anderson Knee Stabler had no significant effect on mean isometric and isokinetic torque production as well as the general agility of college football offensive linemen. It is then recommended that this brace be used as a tool for preventing medial collateral knee injuries in football players. I encourage coaches and athletic trainers to use this brace preventatively on their offensive and defensive linemen, who are susceptible to the forces which might injure the knee. Also, I recommend that this brace be used on any athlete returning to activity after sustaining an injury to his medial collateral ligament.

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APPENDIX A

CYBEX TEST - RAW DATA

Mean Peak Torque Output at Selected Speeds During the Braced and No Brace Conditions

No Brace

	0° per second	30° per second	90° per second	180° per second	300° per second
#1	199.33	238.67	178	138	122
#2	158.67	196.67	164	126.67	108
#3	156	206	160	142.67	127.33
#4	163.33	144.67	138	118.67	98.67
#5	166	152.67	144.67	106.67	107.33
#6	218.67	195.33	158	130.67	105.33
MEAN	176.83	189	157.11	127.23	111.44

Braced

	0° per second	30° per second	90° per second	180° per second	300° per second
#1	228	204.67	164	131.33	96.67
#2	178	173.33	144	128	112
#3	228	231.33	200	144.67	113.33
#4	152	153.33	148.67	123.33	88.67
#5	161.33	176.67	148	136	110
#6	176	206.67	172	133.33	111.33
MEAN	187.22	191	162.78	132.78	105.33

APPENDIX B

SEMO AGILITY TEST - RAW DATA

SEMO Agility Scores During the Braced and No Brace Conditions

No Brace

	#1	#2	scored trial
#1	11:62	11:19	11:19
#2	11:12	11:19	11:12
#3	12:55	12:57	12:55
#4	11:45	10:91	10:91
#5	12:72	13:02	12:72
#6	11:75	11:53	11:53
MEAN	11:87	11:735	11:67

Braced

	#1	#2	scored trial
#1	12:22	11:83	11:83
#2	11:65	11:57	11:57
#3	12:77	12:14	12:14
#4	11:20	11:01	11:01
#5	13:09	12:41	12:41
#6	11:28	11:45	11:28
MEAN	12:035	11:735	11:70