

[Athletic Training]



The Effectiveness of Prophylactic Knee Bracing in American Football: A Systematic Review

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Context: Knee injuries, particularly of the medial collateral ligament (MCL), are the most common injury sustained in American football. In 1979, Anderson et al described a knee brace that could protect uninjured knees from MCL injuries resulting from lateral impact. Since then, a number of light and free-moving bracing devices have been developed. However, the efficacy of prophylactic knee bracing remains in question.

Objective: A systematic review of the efficacy of prophylactic knee bracing in preventing MCL injuries in football players.

Data Sources: Based on MedSearch and PubMed, articles from 1985 to November 2009 were identified with the following keywords and their combinations: *prophylactic*, *prevent injury*, *knee brace*, *prevention*, *medial collateral ligament*, *MCL*, *football*, and *bracing*.

Study Selection: One randomized controlled trial (level 1 study) and 5 prospective cohort studies (level 2 studies) were selected.

Results: The results of the studies were inconsistent; only 1 study showed that prophylactic knee bracing significantly reduced MCL injuries ($P < .05$). In contrast, 2 studies found that knee bracing was associated with an increase in knee injuries.

Conclusions: Prophylactic bracing in American football has not consistently reduced MCL injuries. There remains a lack of evidence to support the routine use of prophylactic knee bracing in uninjured knees. There is limited high-level evidence, bias in the available literature, and confounding variables that limit the current literature.

Keywords: knee; injury prevention; medial collateral ligament; MCL; bracing; American football

Knee injuries in general and medial collateral ligament (MCL) injuries in particular are common in American football.^{5,6,9,11,19} The cost of these injuries in terms of time lost from sports, academics, and quality of life can be substantial.^{12,17} This issue does not discriminate on the basis of age or level of play: from the high school ranks to the professional level.⁷

The cost of bracing is far from negligible.^{12,16} There are the obvious financial implications, but player comfort, performance, and safety must also be considered.

This controversy is reflected in the position statement of the American Academy of Orthopaedic Surgeons (AAOS) on prophylactic bracing: “Prophylactic knee braces may provide

limited protection against injuries to the MCL in football players.⁴ Scientific studies have not demonstrated similar protection to other knee ligaments, menisci, or articular cartilage.” The AAOS concluded that there is insufficient scientific evidence to recommend the use of prophylactic knee braces in all football players.⁴

Many obstacles have led to a dearth of level 1 evidence to support bracing. Albright et al outlined the ongoing controversy stating that the confusion is “a reflection of the degree of difficulty inherent in doing epidemiological studies of sport-related injury patterns in general, and of team sports—where the interplay of all the influential factors make the understanding of injury patterns most demanding.”¹

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In 1979, Anderson et al described a knee brace named the Stabler, which was designed to protect athletes who had previously sustained a MCL injury.⁵ The MCL is the primary restraint to a valgus force, and it has been shown in cadaveric studies to be the first ligament to rupture, followed by the anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL).^{3,10,13,14} In Anderson's series, there were no further injuries reported with brace use.⁵ Excitement generated by this study in professional athletes spawned the interest by parents, coaches, and physicians at all levels of the game.⁷ This brace and the litany of others that followed were designed with a laterally based reinforcement that attempts to prevent injury, specifically to the MCL, during lateral impact.⁵ Subsequent studies have shown that currently available off-the-shelf braces can provide at least 20% to 30% greater resistance to lateral impacts of the magnitude that would cause MCL injury.³

METHODS

The articles reviewed were systematically selected from a search of MedSearch and PubMed with the following keywords and their combinations: *prophylactic, prevent injury, knee brace, prevention, medial collateral ligament, MCL, football, and bracing*. To be included, the articles had to be either a level 1 randomized controlled trial (n, 1) or a well-done prospective cohort study (n, 5). Prospective cohort studies were selected because they represent the next-highest level of evidence and have been used in other disciplines, including public health, to study disease incidence and the effectiveness of interventions. The initial search produced 22 articles; 10 of these were excluded: 5 that dealt with ACL injuries and 5 that were biomechanical studies in cadavers. Of the 12 remaining articles, 6 were either a randomized controlled trial or a prospective cohort study and were thus included in this review. The selection of articles was further limited to English and human participants.

The sole randomized controlled trial was performed at the United States Military Academy among full-contact players in an 8-man intramural football program who were assigned to participate with or without a knee brace.¹⁸ All other studies were prospective cohorts: 2 assessed high school populations^{8,11}; the other 3 involved National Collegiate Athletic Association Division I football players.^{2,12,17}

INDIVIDUAL STUDY DESIGN

Sitler et al assessed the efficacy of a prophylactic knee brace to reduce the frequency and severity of acute knee injuries in intramural tackle football at the United States Military Academy.¹⁸ Given the unique nature of this study population, Sitler was able to control confounding variables not standardized in the other studies,^{1,2,8,11,12} such as the cadets' brand of athletic shoes, the playing surface, athlete exposure, knee injury history, type of brace (Donjoy Ortho Protector knee guard—a double-hinged single upright brace), and brace assignment. Brace wear was mandatory and supervised. If

the cadets failed or refused to wear the braces, they were prohibited from competing. The study of 1396 cadets, followed for over 2 seasons of intramural tackle football, included games and practices. The braces were assigned to the players based on a random table of numbers. There were 236 cadets with a previously injured knee: collateral ligament, meniscal, and prior partial ACL tears. Cadets with more than mild residual instability were excluded. The study population closely resembled high school football players given the cadets' demographics of age, height, weight, and playing experience. The incidence and severity of MCL injuries and other knee injuries were recorded on the basis of athlete exposures (a practice or game), with a total of 21 570 exposures recorded. Injury was defined as an acute trauma to the knee (ligament or meniscus) resulting in loss of at least 1 day of participation.¹⁸

Albright et al evaluated prophylactic knee bracing in National Collegiate Athletic Association Division I football players prospectively over a 3-year period² in the largest and most quoted study on prophylactic bracing. The study included 987 Big Ten Conference football players with stable knees who were not previously injured. Players made the brace decision. A brace in this study was "any device designed to provide protection from a lateral blow to the knee that may result in an MCL sprain."² Fifty percent of the 155 772 knee exposures over the study period were in the braced condition. Braced players were not compared to nonbraced controls. Player exposures with the brace were compared to similar exposures without the brace. The study determined MCL injury rates and severity in the braced-versus-nonbraced condition. A limitation of this study is that there was no standardization of bracing and no attempt to determine which braces the players used. The study did stratify the players on the basis of many factors: frequency of participation (role on the team), position, type of session (contact practice and games included), and pattern of brace wear.

Rovere et al correlated the use of prophylactic braces with injuries sustained by a major college football team.¹⁷ The prospective cohort covered a 4-year period, which included 2 years without bracing, followed by 2 years of bracing. The study was not randomized. The cohort for both periods was the entire team, regardless of position, who were required to wear prophylactic knee braces during all practices and games on both knees. The study used the Anderson Knee Stabler: a double-hinged, single-sided brace. Players with preexisting knee injuries were included. Incidence of injury per 100 players, in addition to severity and mechanism of injury, was recorded, with the following risk factors also being assessed: position, session, and type of playing surface. Collateral ligament injuries (grades I-III) were evaluated with varus or valgus stress testing in 30° of flexion.¹⁷

Hewson et al evaluated the effectiveness of prophylactic knee bracing (Anderson Knee Stabler) to reduce the number and severity of knee injuries in football players.¹² Division I players from a 4-year nonbraced period were matched by position with players from the following 4-year braced period. Offensive and

defensive lineman, linebackers, and tight ends were required to wear braces for all practices and games during the braced period. Players with previous knee injuries were included. There were 28 191 braced and 29 293 nonbraced exposures. The Anderson Knee Stabler was used. The type and severity of injury, the position, the number of days lost from participation, and the rate of knee injury were recorded per 100 players.¹²

Grace et al prospectively evaluated 580 high school varsity and junior varsity football players for 2 seasons.¹¹ The players were matched by height, weight, and position. Bracing was based on parental decision, not assignment, and both single- and double-hinged braces were used (n, 247 and 83, respectively). The players were from various teams; field condition, shoe wear, coaching styles, and brace brand were not controlled. Incidence and severity of knee, ipsilateral ankle, and foot injuries were recorded.¹¹

Deppen et al investigated prophylactic knee braces in a prospective cohort of 524 starting football players from 8 high schools over 4 seasons. Contact exposures and types of injury were recorded.⁸ No player had a prior knee injury, and no attempt was made to stratify players by position, height, or weight. Three schools required braces for all players, whereas 5 schools did not. Brace use was not randomized. There were 41 124 contact exposures (a full-contact practice counted as 1 exposure; games were up to 8 exposures). A knee injury was defined as any knee trauma that resulted in the athlete's missing at least 1 practice or game. The number, type, and mechanism of injury were compared.⁸

RESULTS

Sitler et al (level 1 randomized controlled trial) found that bracing significantly reduced MCL and overall knee injuries ($P < .05$), with 25 injuries in the nonbraced group and 12 in the braced group.¹⁸ The reduction of injury was based on position, with braced defensive players having significantly fewer injuries than those of controls ($P < .005$); no significant difference was found in offensive players. There was also a nonsignificant reduction in the number of ACL injuries in the braced group (12 nonbraced versus 4 braced). The severity of the MCL and ACL injuries was not reduced by knee bracing. Direct lateral knee contact was the most common mechanism of injury (47% of all knee injuries and 68% of MCL injuries). When stratified solely on mechanism of injury, braced players were found to have fewer MCL injuries owing to lateral knee contact, but the difference was not significant ($P > .05$).¹⁸

Albright et al (level 2 prospective cohort study) found a nonsignificant trend toward a lower injury rate for braced players when considering risk factors: position, string, and session ($P > .05$).² Players were more likely to wear braces during perceived danger and practices rather than in games. If another player injured his knee, players perceived it as a time of danger and were more likely to wear their braces. Players thought that bracing limited their performance. Players who started or saw significant playing time were more likely to be

injured in games, and they had a higher number of exposures before injury as compared with the nonplayers, who were more likely to be injured in practice.²

In the Hewson et al study (level 2 prospective cohort study), offensive and defensive linemen, linebackers, and tight ends showed no significant difference (P value not available) in the incidence of knee injuries between braced and nonbraced players.¹² The type and severity of knee injuries were similar regardless of brace use. There was no significant difference in practice time in high-risk positions or in the incidence of season-ending injuries between the braced and nonbraced period (P values not available).¹²

Deppen and Landfried (level 2 prospective cohort study) also found no significant differences in incidence, severity, or mechanism of knee injuries between braced and nonbraced players ($P > .05$).⁸

In stark contrast to the West Point study by Sitler, the study conducted by Rovere et al (level 2 prospective cohort) revealed that the rate of all ligament injuries actually increased during the braced period.¹⁷ During the nonbraced period, there were 6.1 knee injuries per 100 players, compared with 7.5 in the braced period. Unfortunately, there was no mention of the statistical analysis performed, and no P value was given for these findings. Grade I MCL sprains predominated: 67% of all injuries in the nonbraced period and 62% in the braced period. During both periods, offensive linemen sustained the majority of knee injuries, with defensive backs the least susceptible. Most injuries were the result of body contact (76% braced versus 88% nonbraced). There were more ACL injuries with bracing than without (4 versus 2), although this was not significant (P value not available).¹⁷

Grace et al (level 2 prospective cohort study) found more knee injuries ($P < .001$) in players using single-hinged braces as compared to the matched nonbraced group.¹¹ More knee injuries also occurred in the double-hinged braces than in the controls (P value not available), although this was not significant. There was also a dramatic increase ($P < .01$) in ipsilateral ankle and foot injuries in braced players.¹¹

DISCUSSION

Prophylactic knee bracing continues in football players on the high school, collegiate, and professional levels. The evidence on bracing is unclear, as reflected in the AAOS position statement.⁴ In the only randomized controlled trial, Sitler et al found that prophylactic knee bracing significantly reduced MCL injuries.¹⁸ The limitations of this study include the unique population of military cadets in an intramural setting, which may not be generalizable to other at-risk populations, as well as the limited height and weight of the players. A strength of this study is that many confounding variables were controlled, including shoe wear, compliance, and field surface.¹⁸

Albright et al found a trend toward reduced MCL injury with prophylactic knee bracing.² Although the findings were not significant (P value not available), the Big Ten study did help elucidate important points. More experienced players tended



Clinical Recommendation

SORT: Strength of Recommendation Taxonomy

A: consistent, good-quality patient-oriented evidence

B: inconsistent or limited-quality patient-oriented evidence

C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
Prophylactic knee bracing cannot be recommended to prevent or lessen the severity of MCL injuries in American football players. ^{2,12,17,18}	A

For more information about the SORT evidence rating system, see www.aafp.org/afpsort.xml and Ebell MH, Siwek J, Weiss BD, et al. Strength of Recommendation Taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *Am Fam Physician*. 2004;69:549-557.

to have a greater number of exposures before injury and were more likely to be injured in games,² representing the effect of competition. Interestingly, these same players were less likely to wear their braces in games because of their perceived effect on performance. There were many limitations of this study, including the lack of a control group, the voluntary design, the nonrandomized participation, the standardization of field conditions, shoe wear, coaching styles, practice, and brace type.²

The Deppen and Landfried study found no significant difference in injury rates based on bracing, but they did not stratify risk by position, nor did they match players on the basis of weight or size, thereby limiting its generalizability.⁸

Hewson et al concluded that prophylactic knee bracing could not be recommended.¹² The players along the offensive line had the same number of injuries to the MCL regardless of brace use. Grade III MCL injuries in offensive linemen did decrease from 8 to 2 in the braced period, with the total number of grade III MCL injuries decreasing from 15 in the nonbraced group to 8 in the braced group. The difference was not significant. For the defensive line, MCL injuries decreased from 13 to 6, and the total number of MCL injuries in players at risk decreased from 41 in the nonbraced group to 33 in the braced group. These trends, though not statistically significant (*P* value not available), raise questions about the power of the study.¹²

Grace et al found high school players to be at additional risk for ankle and knee joint injuries in the braced limbs while also suggesting that the braced players had a greater risk of MCL injuries.¹¹ This study was not based on exposures; rather, it reported only the number of injuries, thus making it difficult to determine if the players had similar exposure to injury conditions. The finding of increased ipsilateral ankle and foot injuries does raise the question regarding the efficacy of the braces studied, and it calls attention to the potentially adverse effect of the braces on adjacent joints in the braced limb.¹¹

Rovere et al reported that collegiate athletes who were braced had an increased risk of injury.¹⁷ There was no risk reduction during the bracing period, but confounding variables were not controlled (coaching styles and injury treatment protocol).¹⁷

Pietrosimone et al calculated the relative risk of all knee ligament injuries in collegiate football players with bracing.¹⁵ The authors found a relative risk reduction in 3 studies for knee injuries in general and an increased risk of knee injuries in 4 studies based on their formula. No attempt was made in this review to delineate the effect of bracing on specific knee injuries (eg, MCL versus ACL) or severity of these injuries.

Based on the studies available for review, it is difficult to make an evidence-based recommendation about brace wear. The associated risk factors (shoe type, field surface, and position) present an inherent difficulty in studying this subject. Players that have been injured are more likely to wear braces, and teammates of injured players playing the same position are also more likely to wear braces, which introduces selection bias into these studies.¹

CONCLUSION

Consistent level 1 evidence is lacking to suggest that bracing prevents injury or decreases injury severity. A single randomized controlled study supported bracing.¹⁸ The other studies^{1-3,8,11,12,17} were lower levels of evidence and had biases that influenced their conclusions and generalizability. Data do suggest that in the high-risk positions of offensive and defensive line, linebacker, and tight end, bracing may be effective in both preventing and decreasing severity of MCL injuries in the college athlete. Medical evidence does not support the routine use of bracing in high school football players. Some data suggest that when confounders are controlled, players with body sizes similar to those of high school athletes have fewer and less severe MCL injuries with bracing.

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