



PROPHYLACTIC BRACING OF THE COLLEGIATE FOOTBALL KNEE

A REVIEW OF CUSTOM FITTED FUNCTIONAL VS. LATERAL BRACES IN OFFENSIVE LINEMEN

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INTRODUCTION

The book on knee injury is as broad as it is deep. How effective is prophylactic bracing of the knee? How much more protection can be gained from the use of functional braces for prophylaxis? When the decision to utilize braces for prophylaxis, should they be custom fitted, or conventional "off the shelf" types? Of interest to the practitioner is time loss to sport participants; cost to insurance industry; and pain and suffering to the patient. In the early 1970s, Nicholas and Castiglia of Lenox Hill Hospital developed the Lenox Hill Derotation knee brace - for professional football player, Joe Namath¹. From this the industry has blossomed.

During the 1997 and 1998 seasons, we studied the incidence and severity of knee injuries among offensive linemen in a National Collegiate Athletic Association Division I institution. The goal was to compare prophylactic bracing in two styles of [knee braces](#) in a retrospective study. The two braces were prophylactic lateral protective knee braces and custom fitted functional braces. Due to the risk of injury from valgus loading of the knee in offensive linemen, our institutions elected to provide prophylactic bracing to this position during contact activity.

In 1984, the American Academy of Orthopaedic Surgeons (AAOS) categorized knee braces as follows:

- Prophylactic knee braces- those devices designed to prevent or reduce the severity of knee injuries;
- Rehabilitative braces- devices aimed to limit motion of injured knees or those knees following surgical treatment; and
- Functional knee braces- appliances designed to provide stability to unstable knees.

Health care to sport participants is provided collectively by Certified Athletic Trainers, Physical Therapists, Orthotists - Prothetists, and Orthopaedic Surgeons. As a team, we work to develop protective devices for prophylaxis, rehabilitation, and safe return to the sport activity. Adequate protection of the knee requires an understanding of specific biomechanics and corresponding stressed tissue. Initially designed to restrain abnormal knee motions, knee braces have now progressed to provide functional stability.³

Prophylactic knee braces

Baker studied valgus force reduction with protective knee guards and functional knee braces.^{4, 5} Prophylactic lateral brace application has shown to decrease valgus force application to the knee joint.⁶ This mechanism of injury describes common history of injury to the medial knee structures. At West Point, researchers concluded football players in a braced group sustained significantly reduced frequency of knee injuries.⁷ Albright et al. further reported the effectiveness of prophylactic braces.



Surrogate studies have also exhibited the efficacy of functional bracing and the effective control of rotational forces producing injury to the intra-capsular ligaments. Additionally, Erikson et al. studied brace efficacy in reduction of forces along the knee ligaments in cadaver limbs. They found the braces to decrease forces at the point of contact though no significant decrease in stress along the anterior cruciate ligament.⁹

Functional knee braces

Functional knee braces have been expanded into the rehabilitation setting with aggressive rehabilitation protocols of the 1980s.¹ Cawley also stressed the importance of functional brace use in rehabilitation to restore a patient's confidence in activity.¹ With the anterior cruciate deficient patient, Beard reported brace use resulted in fewer episodes of giving way with a perception of stability in the knee.¹⁰ The rationale for this effect is not fully understood.^{10, 11} By using leverage systems, functional braces control excessive movement of the tibia. Extension stops and posterior restraints incorporated in the brace design to prevent hyperextension of the knee.¹² Brace design incorporating bilateral hinges and rigid shells were more effective in transmitting loads.¹³

From the report of the AAOS, functional braces help control unstable knee joints. The questioned support against "giving way" has found support from functional braces. Properly fitted braces used in conjunction with rehabilitation programs are vital adjuncts in the treatment of knee instability.¹

Beynnon reported functional knee braces as providing a protective strain-shielding effect on the anterior cruciate ligament.¹³ Relative to preloading of the knee ligaments, Beynnon could not find increased strain to the anterior cruciate ligaments.¹⁴ Functional knee braces provide restraining influence to control abnormal displacements of the knee⁵ and decrease anterior tibial translation without associated contraction of the musculature of the lower extremity.

PRESENTATION OF DATA

Table 1. Subjects

	1997	1998
Number	20	18
Age (months)	249 (range 217-266)	249 (range 221-274)
Body Mass (lbs.)	290 (range 210-335)	290 (range 231-340)
Height (in.)	74.9 (range 72-77)	74.6 (range 73-76)
Games of Participation	4.95 (range 0-II)	7.4 (range 0-11)
Years of College Participation	2.3 (range 0-4)	2.2 (range 0-4)
Brace Type	Single Lateral Upright Prophylactic Knee Braces (DonJoy)	Defiance, Custom Fitted Functional Knee Brace DonJoy
Days Braces Worn (Contact Practice Sessions)	Tuesday and Wednesday	Tuesday and Wednesday



Table 2. Injuries to Offensive Linemen

1997

Days Missed	Pathology	Severity of Injury	Surgical Intervention
10 - 21 days	Medial Collateral Ligament	Grade II	No
> 22 days	Anterior Cruciate Ligament	Grade III	Yes
> 22 days	Anterior Cruciate Ligament	Grade III	Yes

Table 3. Health Care Costs

1997

Days Missed	Pathology	Severity	Weeks of Tx	Rehab Costs	Surgical Costs	Total Costs
10 - 12 days	MCL	II	3	\$2,475	-	\$2,475
>22 days	ACL	III	30	\$24,750	\$18,000	\$42,750
>22 days	ACL	III	30	\$24,750	\$18,000	\$42,750
						\$87,975

1998

Days Missed	Pathology	Severity	Rehab Costs	Surgical Costs	Total Costs
1 - 2 days	MCL	I	5 days = \$815	0	\$815
1 - 2 days	MCL	I	5 days = \$815	0	\$815

- Rehab Cost per Week based on \$1 65/day

PROCEDURES

During the 1997 season, prophylactic brace use by offensive linemen (offensive center, offensive guard, offensive tackle, and offensive tight end) was embraced. Certified athletic trainers instructed the subjects in proper application of the prophylactic knee braces ([DonJoy](#)) and compliance was monitored. Subjects used both the manufacture's neoprene straps and elastic tape to secure braces to the lateral aspect of the lower extremity.

In the 1998 season, it was decided to provide custom fitted functional knee braces on all varsity offensive linemen and those freshmen receiving athletic scholarship aid. Thus, as non-scholarship student-athletes progress to their second year of participation in the football program, they were fitted with custom functional knee braces. All varsity offensive linemen were fitted with custom functional knee braces ([DonJoy Defiance](#)). This position was selected due to the inordinate number of injuries occurring due to persons often falling across the knees. The members of the offensive line were fitted bilaterally with [custom functional knee braces](#) prior to the beginning of preseason conditioning drills by a single technician. Once the braces were received, each player was instructed individually in the proper application of the brace devices. Braces were worn for all contact practices. During each of the 1997 and 1998 seasons, the Sports Medicine staff including certified athletic trainers and board certified orthopedic surgeons monitored knee injuries. Injury incidence was recorded according to the severity of injury and the specific pathology involved. All injuries were recorded in the format of the Injury Surveillance System (National Collegiate Athletic Association). Following the season, the specific knee injuries were extrapolated and further classified according to the specific pathology involved and the severity of the injury.

DISCUSSION

Subjects

In 1997, prophylactic bracing of college football players was studied in offensive linemen at a division one institution participating in a major athletic conference. Twenty (20) subjects with a mean age of 249 months; mean body weight of 290 pounds; and the average height of 74.9 inches were studied. Subjects averaged participating in 4.95 games and



had 2.3 years of college football experience. All subjects wore bilateral protective knee braces (DonJoy) in contact practice sessions and games (see Table 1).

In 1998, eighteen (18) players were fitted with custom fitted functional knee braces. The average age was 249 months; mean body mass was 290 pounds; height was 74.6 inches. The average participation in games was 7.4 games with 2.2 years of experience (see Table 1).

Pathology, Severity of Injury, and Treatment

Table 2 contains data regarding the injuries of the 1997 and 1998 seasons. In 1997, the isolated Grade II medial collateral ligament sprain was treated aggressively with non-surgical care. The patient returned to activity in a period of thirty days-missing a total of twenty-one practice sessions. The Grade III anterior cruciate tears were treated with arthroscopic surgical reconstruction using patellar tendon autograph. Both cases were withheld from contact practice and condition activities for a period of six months.

In 1998, the two Grade I medial collateral ligament sprains were treated aggressively. Patients were able to return to full activity within two days of the injury.

Economic Considerations

With more and more efforts being placed on controlled medical benefits to insured individuals, the athletic administrator's concern for reimbursement of professional services continues to grow. With the cases presented from the 1997 and 1998 seasons, look at actual costs of the injuries and the impact of prophylactic bracing as a prevention tool.

Athletic administrators are challenged with greater responsibilities relative to providing health care services with shrinking dollars. This phenomenon must be dealt with at all levels of athletic participation from high school, college, to the professional sports arena. Further review of Table 3 reveals the economic impact of knee injury and subsequent care to offensive linemen. The actual costs of the 1997 season include two surgical reconstructions of anterior cruciate ligaments totaling \$45,795. The cost of care for knee injuries in 1998 fell to \$1,630 due primarily to the lack of surgical cases.

Discussion

Based on research of injury prevention, the sports medicine staff decided to provide custom fitted prophylactic knee braces (DonJoy Defiance) to offensive linemen. The costs for this project totaled \$16,200 (30 braces at a cost of \$540 each). Though a significant expenditure, the staff felt the investment was very prudent-especially in terms of injury prevention, quality of life for student-athletes, and further prevention of time loss from activity.

CONCLUSION

This review of literature provides substantial evidence of the protective aspects of protective knee braces to capsular structures of the knee. Likewise, functional knee braces are found to effectively control forces of the tibia, which would produce stresses possibly injuring the capsular and/or anterior cruciate ligaments. Regarding the choice of braces, clinicians have felt improved fit is associated with custom braces and result in less brace migration. Regardless, the choice of brace should be one that can withstand the forces of the activity, especially those selected for contact activity. At this time, it is prudent to recommend bracing for prophylaxis and this endeavor is being done at many institutions-with growing popularity.

In summary, there needs to be a comprehensive study of all division of [football](#) regarding prophylactic nature of knee



bracing. The study needs to track injuries relative to all brace types for prophylaxis-including the lateral protective knee guards and functional knee braces. Many institutions embrace the prophylactic concepts, and further information is needed to decide on the cost to benefit ratio of brace usage. Further, if protective knee braces are selected, what differential is afforded from custom fitted versus the 'off-the-shelf' brace styles.