Novel adaptive ACL Brace Provides Superior Stabilization Compared to Static Brace During Functional Hop Tests in ACL-Deficient Subjects: A Motion Analysis Study

Abstract

Introduction: Anterior cruciate ligament (ACL) tears are among the most severe injuries in sports. Conventional bracing has not been shown to provide substantial stabilization benefits.

Purpose : This study aimed to compare the stabilization effects of a novel adaptive ACL brace (NAB) with those of a standard passive brace.

Methods: Twelve ACL-deficient participants each performed in a random order two sets of three functional one leg hop tests: drop jump (DJ), single leg crossover hop (CO), and single leg 90° rotational hop (RH). Once while wearing the NAB e and once with a traditional passive ACL brace. Kinematic data were recorded using an 8-camera optoelectronic system. Repeated-measures ANOVA was applied to compare brace and time effects .

Results: No significant differences in knee flexion angles were observed between braces across the tests. Knee flexion during landing was significantly lower in the CO) compared with the (DJ) and (RH) ($p < 0.01$). In the DJ, wearing the NAB resulted in significantly lower knee valgus angles compared with the static brace ($p < 0.01$). During the CO, wearing NAB resulted in a significantly both lower knee valgus ($p < 0.01$), and knee rotation angles ($p < 0.01$) throughout landing compared with the static brace. In the RH, a significant brace-by-time interaction was observed for knee valgus ($p < 0.01$) and knee rotation ($p < 0.05$).

Conclusions: The findings demonstrated that the NAB) provides superior stabilization compared to a traditional brace, particularly at high risk angels:

Introduction

Anterior cruciate ligament (ACL) tears are among the most common and severe injuries in sports, with more than 250,000 cases reported annually in the United States (Ma R et aal 2022). Between 2004 and 2014, a 22% increase in ACL injuries was observed among young athletes aged 13–17 years. In most cases, reconstruction surgery is required, followed by approximately nine months of rehabilitation (Herzog MM et 2018. Slater et al 2019) Although about 80% of athletes return to competitive play, only 50% regain their pre-injury level of performance, as evidenced by reduced playing time and lower performance statistics (Vaudreuil NJ et al 2021) , Furthermore, up to 30% of young athletes sustain a second ACL tear—either ipsilateral or contralateral—within three years of their first injury (Mody KS et al 2022 Webster KE 2016, Della Villa F et ak 2021) . The rising incidence of ACL injuries, their occurrence at increasingly younger ages, the high risk of re-injury (Montalvo AM et al 2019),, and persistent post-recovery performance deficits have generated growing interest in injury-prevention strategies.

One commonly employed preventive measure is bracing. Surveys show that 55–65% of orthopedic physicians in the National Football League (NFL) and National Collegiate Athletic Association (NCAA) recommend braces following isolated ACL tears ((Ma R, et al 2022 Perrone GS et al 2019) However, the biomechanical and clinical effectiveness of bracing remains controversial. Some studies suggest that bracing can restrict knee valgus during landing (Gentile, JM et al 2021) , reduce knee-joint impact,(Hacker SP et al 2018) enhance proprioception (Palm HG et al 2012) and limit knee rotation (Hanzlíková I et al 2019 , Giotis D 2016) Conversely, other studies have reported that bracing has no significant effect than soft brace on knee valgus (Moon J 2018) no effect on knee rotation (Giotis D et ak 2013) and even to increases knee rotation among ACL deficient subject (Focke A et al 2020) Prospective studies did not

show any prevention effect between ACL brace or sleeves (Ackerman DR et al 2023 Birmingham TB et al 2008)

Several factors may explain the limited protective effect of conventional bracing. ACL injury mechanism is complex, involving multi-planar forces such as anterior tibial translation, valgus collapse, and internal/external rotation. Typically, during injury, the tibia rotates externally while the hip rotates internally (Kiapour AM et al 2016, . Johnston JT et al 2018) In addition, ACL loading is maximal when the knee is flexed at approximately 30°, and injuries usually occur during high-velocity movements such as landing or cutting maneuvers. Recently, more advanced dynamic braces have been introduced (La Prade Rf et al 2017, Tomescu S et al 2018) such as the Össur Rebound brace, which has demonstrated reductions in meniscal strain and ACL loading during daily activities. However, these effects have not been consistently observed under functional athletic conditions.

To address these limitations, we propose a novel adaptive dynamic brace. This brace utilizes knee-flexion motion between 15° to 45° during landing or directional changes to generate a posteriorly directed force on the tibia while simultaneously restricting rotation. In previous studies ,*in vitro* study (Buchman A et al 2025) performed on healthy subjects using pressure sensors, the adaptive dynamic brace produced significantly greater posterior and rotational stabilization forces on the tibia opposing ACL injury mechanisms during: : orthopedic stability test , functional and explosive tasks compared to a static brace. In another study (Gottlieb R et al 2025) performing field tests among healthy athletes the Novel adaptive brace improved hamstring muscle endurance performance an indicator for restraining tibia anterior translation. reduces dynamic valgus angle with no impairment on horizontal performance and with minimal impairment om horizontal performance compared to no bracing.

Based on these findings, the present study employed motion analysis to compare knee kinematics between the novel dynamic brace and a traditional static brace during high-risk functional athletic tasks among ACL deficient subjects.

Materials and methods

Participants

This study was approved by XXXXXXXX Written informed consent was obtained from all participants prior to enrollment.

Twelve male adults with chronic ACL deficiency participated (mean age, 30.2 ± 6.4 years; height, 1.76 ± 0.1 m; body mass, 78 ± 3 kg). Each underwent a standardized clinical evaluation by a sports orthopedic surgeon before enrollment.

Inclusion criteria:

MRI-confirmed complete ACL tear sustained through a non-contact mechanism. Positive Lachman test (≥ grade 1) compared with the contralateral knee. Preserved posterior, collateral, and posterolateral stability, with full knee range of motion. At least 3 months post-injury without surgical reconstruction. Completion of a minimum of 2 months of physiotherapy .Failure to return to pre-injury sports activity, particularly in cutting or directional change maneuvers′–Return to Play questionnaire score between 50 and 80 (out of 100).

Exclusion criteria:

Contralateral knee injury. Other musculoskeletal or neurological impairments of the lower limbs that could compromise stability (e.g., ankle instability, prior ankle surgery, hip pathology, or neurological deficits affecting strength). Intra-articular fractures of the lower extremities (e.g., tibial plateau or ankle joint fractures).

3D Motion Analysis Protocols

General Procedures

The study was conducted in the Privet Motion Analysis Laboratory. All tests were performed and analyzed by an independent PhD-level physiotherapist with 25 years of experience in motion analysis.

Lower-limb kinematics were recorded using an eight-camera motion capture system (Vicon, Oxford Metrics Ltd., UK) operating at 200 Hz. A full-body Plug-in Gait marker set was used, with reflective markers placed bilaterally on key anatomical landmarks: anterior/posterior superior iliac spines, greater trochanters, femoral epicondyles, tibial tuberosities, malleoli, calcanei, and first and fifth metatarsal heads. Additional marker clusters were secured to the thighs and shanks to minimize soft tissue artifacts

Marker trajectories were filtered using a fourth-order zero-lag Butterworth low-pass filter at 6 Hz. (Charalambous, CP 2014) Initial contact was defined as the first frame in which the foot visibly contacted the ground. Kinematic variables extracted from initial contact to peak knee flexion included knee flexion angle, knee valgus/varus angle, and tibial internal/external rotation.

Testing was supervised by a physiotherapist with >15 years of clinical experience. Braces were fitted according to manufacturer guidelines and adjusted for comfort and stability. Participants practiced tasks until confident, and each test was repeated three times. For safety, the order of tasks was arranged by increasing physical load, and progression was permitted only after successful completion of the prior task.

Functional Hop Tests

Drop Jump (DJ) – Vertical Loading

Participants stood on a 30-cm box and, on command, stepped forward to land on one leg, immediately performed a maximal vertical jump, and landed again on the same

leg. Three successful trials were required, defined as stable landings without hesitation or additional steps (Baca A 1999)

Crossover Single-Leg Hop (CO) – Horizontal/Rotational Loading

Participants began in single-leg stance 50–70 cm lateral to a centerline, hopped forward crossing the line to land on the same leg, and then hopped back across to the other side. They were instructed to stabilize for at least 2 seconds after landing. A successful trial required two clean line crossings and stable landings (Logerstedt, D, et al. 2012)

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90° Rotational Hop (RH) – Vertical and Rotational Loading

Participants stood 40–60 cm from a measurement tape and hopped forward on one leg while simultaneously rotating 90° in the air, landing facing perpendicular to the starting orientation. Immediately, they performed a vertical jump and landed again on the same leg, stabilizing for 2 seconds. Successful trials required full rotation and stable landings (Dingenen B et al 2019)

ACL Braces

Each participant completed the three hop tests twice in random order: once wearing a commercial static ACL brace (DonJoy ACL Everyday Knee Brace, DJO, 32 cm) and once wearing a prototype variable dynamic brace (OnCourt R, Israel, 22 cm) (Figure 1).

Adaptive Dynamic Brace:

Structure: Shortened plastic frame with a femoral strap and tibial strap. At the hinge, an eccentric tension mechanism connected to two posteriorly crossed cables

attached distally to calibrated springs (Nordia Springs, Israel). Each 1 cm spring elongation generated ~20 N force, based on prior in vitro validation (24). Action: During knee flexion beginning at 15°, hinge motion increased cable traction, stretching the springs and generating a posteriorly directed stabilizing force with a counter-rotational component. Force peaked at ~30° flexion and decreased gradually, approaching zero by 50°

Figure 1: Brace used in the experiment. Left Dynamic adaptive brace. Right Static ACL brace.

Statistical Analysis

Data were analyzed using SPSS (IBM Corp., Armonk, NY), version 26. The following kinematic parameters were calculated and compared for each participant and test: knee flexion angle, valgus/varus angle, and internal/external rotation. Data were evaluated throughout the landing phase, from initial contact (the moment the participant's foot touched the ground) to maximal knee flexion. An average of the three successful attempts was calculated . A one-way repeated-measures ANOVA was used to assess

condition effects, and a two-way repeated-measures ANOVA was performed to examine time effects. Statistical significance was set at $p < 0.05$. Statistical power was calculated according to chi-square criteria and exceeded 0.80, indicating strong test sensitivity.

Results

Safety

All participants successfully completed the test procedures without experiencing symptoms of knee instability, pain, or discomfort while using either brace.

	Sagittal		Frontal		Transverse	
Test	**S**	**D**	**S**	**D**	**S**	**D**
DJ	**35.4±1.3**	**33.4±1.2**	**6.4±1.2**	**4.9±2.2***	**7.2±1.5**	**6.9±1.4**
CO	**31.5.±0.9****	**30.2±0.8***	**7.4±1.7**	**5.8±2.2***	**5.8±4.1**	**1.6±2.1***
RH	**36.1±1.5**	**36.3±1.7**	**5.1±1.4**	**4.3±1.5**	**6.4±1.6**	**5.2±1.4**

Table 1: Knee angels average at initial contact

***p**<0.05 significance between braces

****p**<0.05 significance between hops

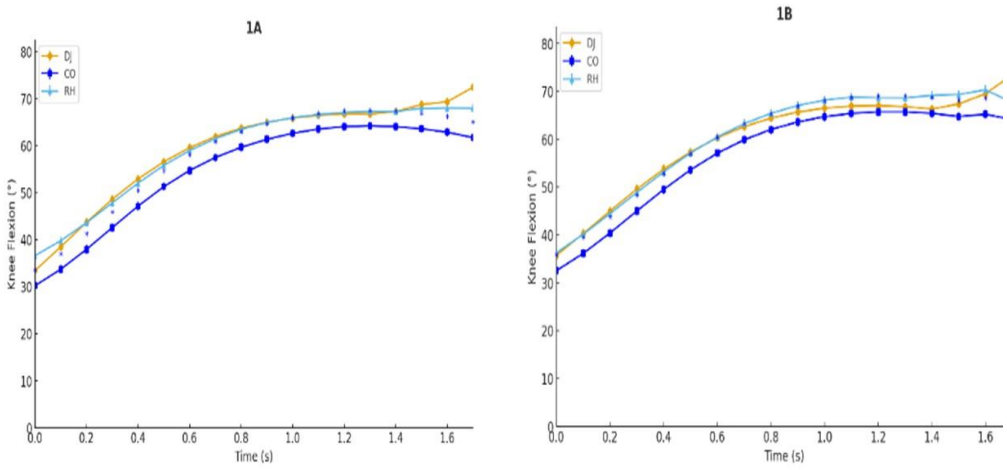

Figure 2 ; Knee flexion angles during landing at three types of test. a variable dynamic brace b static brace. DJ ; drop jump, CO cross over hop RH 90 degree rotation hop. *p<0.05

Drop Jump

No statistical differences were observed between the two braces in knee flexion during landing (Figure 2a). Wearing the adaptive dynamic brace resulted in a significant reduction in knee valgus from initial contact throughout landing compared with the static brace ($p < 0.01$; Figure 2b, Table 1). Knee rotation angles at initial contact were also lower with the adaptive dynamic brace compared to the static brace, but this difference did not reach statistical significance and as knee flexion increased this effect was diminished and rotatiotion angles were similar.

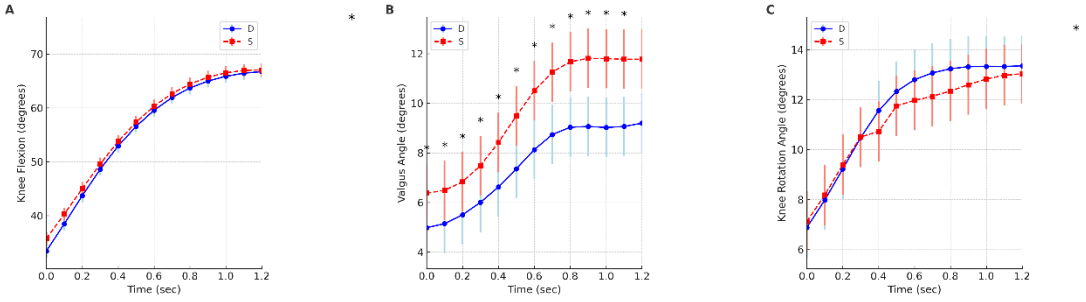

Figure 3: Kinematic parameters during the DJ a: sagittal plane, b: valgus plane. C: transvers plane blue variable dynamic red : static *p<0.05 difference between braces

Crossover Hop

No significant differences were observed between the braces in knee flexion angle (Figure 3a). However, knee flexion angles were significantly lower in both braces compared with the Drop Jump (DJ) and Rotation Hop (RH) tests ($p < 0.01$; Figures 1a, 1b). Wearing the adaptive dynamic brace resulted in significantly lower knee valgus and rotation angles from initial contact throughout landing compared with the static brace ($p < 0.01$; Figure 3b).

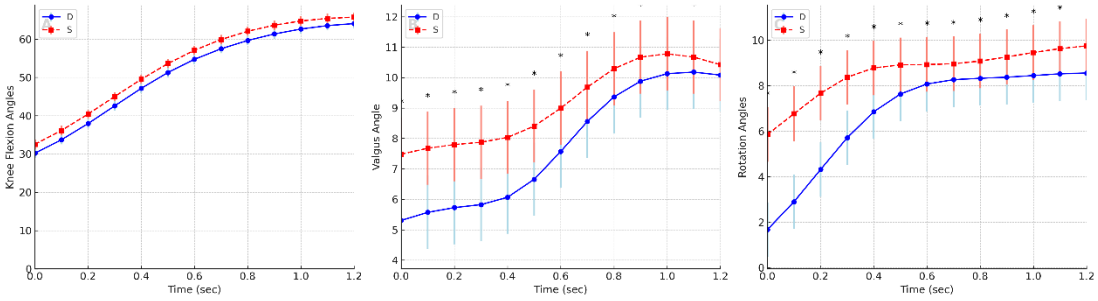

Figure 4: Kinematic parameters during the CO a: sagittal plane, b: valgus plane. c: transvers plane blue: variable dynamic red : static *p<0.05 difference between braces

90° Rotation Hop

No significant differences were observed between the braces in knee flexion angle during landing. Wearing the adaptive dynamic brace was associated with reduced, though non-significant, knee valgus and rotation angles at initial contact and during low flexion angles (up to 40° of knee flexion). These effects progressively diminished as flexion increased toward 50°. In contrast, during the terminal phase of landing (65°),

the static brace demonstrated lower valgus and rotation angles compared to the adaptive dynamic brace. These differences produced only significant brace-by-time interactions for knee valgus ($p < 0.05$; Figure 5b) and knee rotation ($p < 0.05$; Figure 5c).

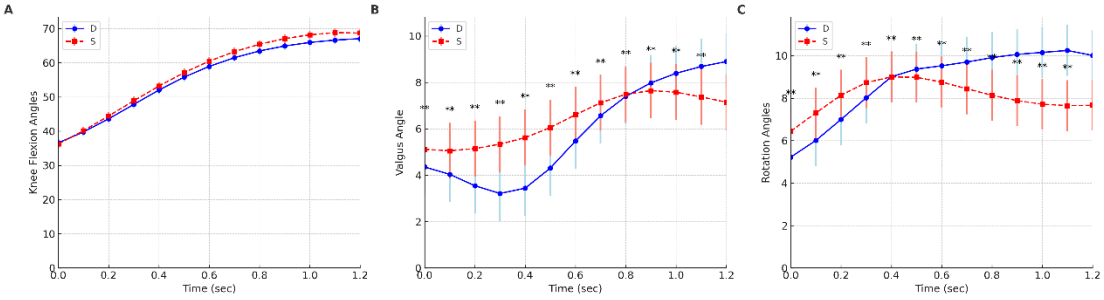

Figure 5: Kinematic parameters during the RH a: sagittal plane, b: valgus plane. c: transvers plane blue variable dynamic red : static

**p<0.05 difference between braces and time interaction

Discussion

This study is the first to compare the effects of a adaptive dynamic ACL brace, designed to deliver stabilization forces at initial flexion angles associated with a high risk of ACL injury, with those of a static commercial brace during functional hop tests that replicate athletic maneuvers performed on court.

The main findings demonstrate that during the crossover hop (CH) a task that reproduces ACL injury mechanisms by combining low knee flexion, valgus, and rotation (McAmis, N. E et al 2021 Ebert JR et al et al 2021) wearing the adaptive dynamic brace produced a significant protective effect: reduced knee valgus and rotation angles throughout all landing phases. We also found that during drop jump (DJ) landings, the adaptive dynamic brace resulted in lower valgus angles compared to the static brace. Furthermore, during hop tests (McAmis, N. E et al 2021) that induced deeper flexion and rotation, significant differences in the stabilization effects of the two braces were observed over time. Specifically, the adaptive dynamic brace reduced valgus and rotation angles at initial flexion angles, whereas the static brace demonstrated greater reductions later in the landing phase.

Our results align with previous studies (Beynnon BD et al 1992 Fleming BC, et al 2000 , Jalali M et al 2018 Lu TW et al 2006) indicating that although current static braces may produce measurable kinematic effects during daily activities and early rehabilitation, their protective effects during athletic maneuvers remain less clear. Under high-demand tasks such as drop jumps or directional changes, braces have been reported to improve subjective perceptions of stability (Wu GK et al 2001) increase knee flexion during landing, and enhance proprioceptive feedback (Hangalur G H et al 2016) However, their direct biomechanical effects on injury-related stabilization have been inconsistent, largely due to differences in testing protocols. For example, during tasks involving vertical loading at deep flexion angles or vertical load combined with rotation in deep flexion (Palm HG, et al 2012 , Hanzlíková I et al 2019) static braces

demonstrated significant rotary stabilizing effects compared with no brace, but not when compared with soft braces (Giotis D et al 2016 Moon J et al 2018) . In contrast, during tasks involving rotational loading at low flexion angles, static braces were not found to produce significant stabilization (Giotis D et al 2013 Focke A et al 2020 . This is probably why prospective studies (Ackerman DR et al 2023 Birmingham TB et al 2008) performed among athletes found that continuous bracing use reduces overall traumatic knee injuries but not ACL injury rates.

These prior findings are in line with the present finding we observed significant difference between braces stabilization effect and time interaction During rotational hops (RH) at deep flexion angles (~50°) the static brace provided partial both valgus and rotational stabilization. However, at lower flexion angles from initial contact (32° degrees) to around (~50°) the adaptive dynamic brace demonstrated superior stabilization, reducing both valgus and rotation angles compared with the static brace.

An additional finding supporting the superior effect of the adaptive dynamic brace was the reduction in valgus angle during DJ landings. This result is also consistent with previous studies reporting (Gentile, J. M et al 2023) that static braces reduce valgus angles compared with no brace but these effects were not significant in other studies when the static brace was compared with soft brace (Moon J et al 2018) Which implies that the effects of static braces may not result from mechanical restriction, but rather from modifications in muscle activation(Wu GK et al 2001)]. By contrast, the significant effect of the adaptive dynamic brace despite its shorter frame and consequently shorter lever arm compared with the static brace are in line with our previous investigation(Buchman A et al 2025, Gottelibe R and Greenberg S 2025) suggests that the protective effect observed is attributable to its direct dynamic mechanical stabilization mechanisms rather than passive stabilization or neuromuscular modulation. The lack effect of the adaptive variable brace on rotation angles is due to the moderate rotational demand in this test compared to other test (.McAmis, N. E et al 2021)

The clinical relevance of these findings is underscored by the fact that all participants were ACL-deficient, assessed after rehabilitation but unable to return to pre-injury activity levels. Such patients are expected to demonstrate greater knee valgus and rotational motion compared with healthy controls (Yang C et al 2018) . Therefore, any additional external stabilization such as provided by the adaptive dynamic brace may enhance functional performance and facilitate return to full activity.

This study has several limitations. First, healthy knees were not included as a control group. This decision was based on prior several studies [13-14, 16-17] that failed to demonstrate consistent or significant biomechanical effects of passive bracing, leading us instead to use a static commercial brace as the control condition. Second, the sample size was relatively small. However, given the considerable variability in landing patterns among subjects, increasing the number of participants would not necessarily have guaranteed greater statistical significance.

Conclusion

In summary, the present study demonstrates that wearing a adaptive dynamic brace have a superior stabilization effect compared to static brace as results by significantly reduces ACL injury risk during athletic maneuvers by decreasing knee valgus and rotation at low flexion angles. The consistent effect of the adaptive brace on knee biomechanics during the initial landing phase, observed across all tasks highlights its potential as a mechanical stabilizer for injury prevention and to improve conservative treatments outcomes is active subjects. Future studies should evaluate the long-term effects of wearing a adaptive dynamic brace on actual injury rates.

References

Ackerman DR, Ptasinski AM, Edmond T, et al. Prophylactic Knee Bracing in Offensive Linemen of the National Football League: A Retrospective Analysis of Usage Trends, Player Performance, and Major Knee Injury. Orthop J Sports Med. 2023;11(8):23259671231191767.

Baca A. "Comparison of methods for analyzing drop jump performance." Medicine and Science in Sports and Exercise 31.3 (1999): 437–442.

Beynnon BD, Pope MH, Wertheimer CM, et al. The effect of functional knee-braces on strain on the anterior cruciate ligament in vivo. J Bone Joint Surg Am 1992;74(09):1298–1312.

Birmingham TB, Bryant DM, Giffin JR, et al. A randomized controlled trial comparing the effectiveness of functional knee brace and neoprene sleeve use after anterior cruciate ligament reconstruction. Am J Sports Med 2008;36(04):648–655.

Buchman A, Kazakevich E, Greenberg S, et al. In vitro analysis of stabilization forces applied through a dynamic spring ACL brace compared to a static one, examined through a range of knee tests. MOJ App Bio Biomech. 2025;9(1):51-57. DOI: 10.15406/mojabb.2025.09.00225

Charalambous CP. Measurement of lower extremity kinematics during level walking. In *Classic Papers in Orthopaedics*; Banaszkiewicz, P., Kader, D., Eds.; Springer: London, UK, 2014; pp. 397–398.

Della Villa F, Hägglund M, Della Villa S, et al. High rate of second ACL injury following ACL reconstruction in male professional footballers: an updated longitudinal analysis from 118 players in the UEFA Elite Club Injury Study. *British Journal of Sports Medicine* 2021;55:1350–1357.

Dingenen B, Truijen J, Bellemans J, Gokeler A. Test-retest reliability and discriminative ability of forward, medial and rotational single-leg hop tests. Knee. 2019 Oct;26(5):978–987.

Ebert JR, Du Preez L, Furzer B, Edwards P, Joss B. Which Hop Tests Can Best Identify Functional Limb Asymmetry in Patients 9–12 Months After Anterior Cruciate Ligament Reconstruction Employing a Hamstrings Tendon Autograft? IJSPT. 2021;16(2):393–403. doi:10.26603/001c.21140

Fleming BC, Renstrom PA, Beynnon BD, et al. The influence of functional knee bracing on the anterior cruciate ligament strain biomechanics in weightbearing and non weightbearing knees. Am J Sports Med 2000;28(06):815–824.

Focke A, Steingrebe H, Möhler F, et al. Effect of Different Knee Braces in ACL-Deficient Patients. Front Bioeng Biotechnol. 2020;8:964.

Gentile JM, O'Brien MC, Conrad B, Horodyski M, Bruner ML, & Farmer KW. A Biomechanical Comparison Shows No Difference Between Two Knee Braces used for Medial Collateral Ligament Injuries. Arthroscopy, Sports Medicine, and Rehabilitation, 3(3), e901–e907. 2021.

Giotis D, Paschos NK, Zampeli F, Pappas E, Mitsionis G, Georgoulis AD. Bracing can partially limit tibial rotation during stressful activities after anterior cruciate ligament reconstruction with a hamstring graft. Orthop Traumatol Surg Res 2016;102(05):601–606.

Giotis D, Zampeli F, Pappas E, Mitsionis G, Papadopoulos P, Georgoulis AD. Effects of knee bracing on tibial rotation during high loading activities in anterior cruciate ligament-reconstructed knees. Arthroscopy 2013;29(10):1644–1652.

Gottlieb R, Greenberg S. The Effect of a Novel Dynamic Hamstring Brace on Muscle and Athletic Performance Tests among Young Basketball Players. Journal of Human Kinetics. 2025. doi:10.5114/jhk/209073.

Hacker SP, Schall F, Niemeyer F, Wolf N, Ignatius A, Dürselen L. Do prophylactic knee braces protect the knee against impacts or tibial moments? An in vitro multisensory study. Orthop J Sports Med 2018;6(11).

Hangalur G, Brenneman E, Nicholls M, Bakker R, Laing A, Chandrashekar N. Can a knee brace reduce the strain in the anterior cruciate ligament? Prosthet Orthot Int. 2016;40(3):394-399.

Hanzlíková I, Richards J, Hébert-Losier K, Smékal D. The effect of proprioceptive knee bracing on knee stability after anterior cruciate ligament reconstruction. Gait Posture 2019;67:242–247.

Herzog MM, Marshall SW, Lund JL, Pate V, Mack CD, Spang JT. Trends in incidence of ACL reconstruction and concomitant procedures among commercially insured individuals in the United States, 2002–2014. Sports Health 2018;10(06):523–531.

Jalali M, Farahmand F, Esfandiarpour F, et al. The effect of functional bracing on the arthrokinematics of anterior cruciate ligament injured knees during lunge exercise. Gait Posture 2018; 63:52–57.

Johnston JT, Mandelbaum BR, Schub D, et al. Video Analysis of Anterior Cruciate Ligament Tears in Professional American Football Athletes. Am J Sports Med. 2018;46(4):862–868.

Kiapour AM, Demetropoulos CK, Kiapour A, et al. Strain Response of the Anterior Cruciate Ligament to Uniplanar and Multiplanar Loads During Simulated Landings. Am J Sports Med. 2016;44(8):2087–96.

La Prade RF, Venderley MB, Dahl KD, Dornan GJ, Turnbull TL. Functional Brace in ACL Surgery: Force Quantification in an In Vivo Study. Orthop J Sports Med. 2017 Jul;5(7).

Logerstedt D, Grindem H, Lynch A, et al. Single-legged hop tests as predictors of self-reported knee function after ACL reconstruction: the Delaware-Oslo ACL cohort study. Am J Sports Med. 2012;40(10):2348-2356.

Lu TW, Lin HC, Hsu HC. Influence of functional bracing on the kinetics of anterior cruciate ligament-injured knees during level walking. Clin Biomech 2006;21(05):517–524.

Ma R, Sheth C, Fenkell B, Buyuk AF. The Role of Bracing in ACL Injuries: The Current Evidentiary State of Play. J Knee Surg. 2022;35(3):255–265.

McAmis NE, Hardisty AV, Feinn RS, & Garbalosa JC. A comparison of kinematic demands placed on the knee and hip during two ACL return-to-sport screening maneuvers. Physical Therapy in Sport. 2021;52:155–161.

Mody KS, Fletcher AN, Akoh CC, Parekh SG. Return to Play and Performance After ACL Reconstruction in NFL Players. Orthop J Sports Med. 2022 Mar;10(3).

Montalvo AM, Schneider DK, Yut L, et al. "What's my risk of sustaining an ACL injury while playing sports?" A systematic review with meta-analysis. Br J Sports Med 2019;53:1003–1012.

Moon J, Kim H, Lee J, Panday SB. Effect of wearing a knee brace or sleeve on the knee joint and ACL force during drop jumps. Knee. 2018;25(6):1009–1015.

Palm HG, Brattinger F, Stegmueller B, Achatz G, Riesner HJ, Friemert B. Effects of knee bracing on postural control after ACL rupture. Knee 2012;19(05):664–671.

Perrone GS, Webster KE, Imbriaco C, et al. Risk of secondary ACL injury in adolescents prescribed functional bracing after ACL reconstruction. Orthop J Sports Med 2019;7(11):2325967119879880.

Slater LV, Wasserman EB, Hart JM. Trends in recurrent ACL injuries in college and high school sports: 2009–2017. Orthop J Sports Med. 2019;7(11).

Tomescu S, Bakker R, Wasserstein D, Kalra M, Nicholls M, Whyne C, Chandrashekar N. Dynamically tensioned ACL functional knee braces reduce ACL and meniscal strain. Knee Surg Sports Traumatol Arthrosc. 2018;26(2):526–533.

Vaudreuil NJ, van Eck CF, Lombardo SJ, Kharrazi FD. Economic and Performance Impact of ACL Injury in NBA Players. Orthop J Sports Med. 2021;9(9).

Webster KE, Feller JA. Exploring the high reinjury rate in younger patients after ACL reconstruction. Am J Sports Med 2016;44(11):2827–2832.

Wu GK, Ng GY, Mak AF. Effects of knee bracing on the sensorimotor function of subjects with ACL reconstruction. Am J Sports Med 2001;29(05):641–645.

Yang C, Tashiro Y, Lynch A, Fu F, Anderst W. Kinematics and arthrokinematics in chronic ACL-deficient knees. Knee Surg Sports Traumatol Arthrosc. 2018;26(5):1406–1413.

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Conclusion

The dynamic brace demonstrated a significantly superior protective effect compared to the static brace in reducing high-risk knee motions during athletic maneuvers. Specifically, it produced a significant reduction in knee valgus angles from initial contact to final landing across all three hop tasks. Furthermore, the dynamic brace decreased knee rotation angles during crossover maneuvers—tasks that demand a lower knee flexion angle—when compared with drop jumps and rotational hops.

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