

**Beyond Jump Height: Monitoring Countermovement Jump Metrics Across the Anterior
Cruciate Ligament Rehabilitation Journey**

Chris Bishop^a, Luca Maestroni^{a}, Francesco Bettariga^{b,c*}, Matthew Jordan^{d*}, Paul Read^{e*}, and
Anthony Turner^{a*}*

Accepted for Publication in Physiotherapy Theory and Practice (18-09-2026)

a) London Sport Institute, Faculty of Science and Technology, Middlesex University,
London, UK

b) Human Performance Research Centre, University of Technology Sydney, Sydney,
Australia

c) Exercise Medicine Research Institute, Edith Cowan University, Perth, Australia

d) Integrative Neuromuscular Sport Performance Lab, Faculty of Kinesiology, University of
Calgary, Calgary, Canada

e) London Sport Institute Dubai, Middlesex University Dubai, Dubai, United Arab Emirates

Correspondence: Chris Bishop

Address: London Sport Institute, StoneX Stadium, Greenlands Lane, London, NW4 1RL, UK

Email: C.Bishop@mdx.ac.uk

Word Count: 3,360

ABSTRACT

The countermovement jump (CMJ) test serves as a popular assessment method owing to its relative simplicity, time-efficient nature and ability to elicit consistent and repeatable measures. However, the choice of metrics is vast when undertaking testing with force platforms, which makes it difficult for practitioners to know which ones to monitor and why. This article outlines some of the common challenges that practitioners face when considering the use of this test, some objective markers and subjective information to guide its implementation in practice, in addition to a blend of logic-led reasoning and referral to the existing evidence base, to consider which CMJ metrics may be most appropriate for practitioners to monitor during the rehabilitation journey of those who suffer an anterior cruciate ligament (ACL) injury.

Keywords: Capacity restoration; physical therapy; physiotherapy.

34 INTRODUCTION

35 In sport, practitioners frequently use jump testing as a means of profiling athletic performance,
36 determining neuromuscular readiness, and as part of an athlete's ongoing injury rehabilitation
37 journey (Bishop et al. 2022; Bishop et al. 2023; Jordan et al. 2015; Morris et al. 2026; Rebelo et
38 al. 2026). Its popularity stems from several factors such as its relative simplicity to perform, time-
39 efficient nature, and kinematic correspondence to a number of sporting actions (Bishop et al.
40 2023). Vertical jump testing is, and has been, commonly implemented for years in athletic
41 performance settings. In rehabilitation settings however, there has historically been a common use
42 for horizontal jump testing – specifically, variants of single leg hop testing, typically used for the
43 purpose of identifying knee function in anterior cruciate ligament (ACL) patients (Barber et al.
44 1990; Noyes et al. 1991; Grindem et al. 2011; Rohman et al. 2015). Despite hop testing offering
45 some degree of clinical utility for those with limited budgets, a broad range of more recent
46 literature has indicated that the commonly reported outcome measure of 'distance hopped' is
47 insufficient at detecting relevant capacity deficits (e.g., knee joint work or stretch-shortening cycle
48 function) during the rehabilitation process for ACL injuries (Kotsifaki et al. 2020; Losciale et al.
49 2020; Lloyd et al. 2020). Consequently, evidence has come to light suggesting that vertical jump
50 testing may be more sensitive at detecting residual deficits in physical capacity than horizontal
51 jump testing in those who have suffered prior ACL injuries (Kotsifaki et al. 2022).

52 Numerous vertical jump assessments are available for practitioners to consider such as: the
53 countermovement jump (CMJ), squat jump, drop jump, and their associated unilateral versions, to
54 name a few. However, for a long time in athletic performance research, and more recently it seems
55 in injury rehabilitation literature, the CMJ and unilateral CMJ are being routinely implemented

more than other jump test options (Claudino et al. 2017; Fort-Vanmeerhaeghe et al. 2022; Kotsifaki et al. 2022). Thus, despite the common implementation of the CMJ, the discussion around which metrics to monitor undoubtedly still remains. This becomes increasingly challenging for practitioners to comprehend when testing is undertaken on force platforms, given upwards of 100 metrics can often be instantly obtained. Therefore, the purpose of this commentary is threefold. Firstly, to provide a brief commentary relating to some of the challenges associated with CMJ testing. Second, to provide some suggestions as to when CMJ testing should be integrated into routine testing practice. Thirdly, to offer some suggestions relating to which force-time metrics rehabilitation professionals may consider monitoring, to help them inform day-to-day decision-making in athlete populations who have suffered from an ACL injury.

CHALLENGES WITH USING THE COUNTERMOVEMENT JUMP TEST

Before discussing which CMJ metrics may be useful for rehabilitation professionals, it is important to outline some of the challenges with the assessment and associated variables that can be extracted once an athlete has completed a jump. This will help to set the scene as to why some measures are potentially less useful, so that from a practical perspective, practitioners can likely disregard a number of metrics before any subsequent data analysis occurs. Important to note at this stage, this philosophy represents the author team's opinion only. However, this opinion is predominantly formed off the basis of understanding fundamental exercise science principles – which the author team propose are vital when selecting CMJ measures.

Firstly, the most obvious challenge centers around the volume of metrics available when the assessment is completed on force platforms. Popular manufacturers (e.g., Hawkin Dynamics,

VALD) can produce upwards of 100 metrics instantaneously. Further to this though, many of these (when viewed by name), appear to be highly similar with minute discrepancies in definition, that are not always obvious to the practitioner. Thus, it is not always clear what each metric represents or how each of them are calculated.

Secondly, some measures are inherently more reliable than others. Reliability represents a critical component of any test measure (Bishop et al. 2022; Turner et al. 2015), and one that should not be compromised on. Whilst 10% measurement error is often commonly cited (Cormack et al. 2008) when using the coefficient of variation (CV) statistic, it seems both sensible and pragmatic to suggest that practitioners should probably aim for metrics to exhibit not much more than 5% (Turner et al. 2015). The relevance here being that when practitioners are trying to quantify whether a change in test score is greater than the CV (which determines whether it is real or not), a larger change is inherently required to fall outside the ‘noise of the test’ if the measurement error is high. Importantly though, it is recommended that practitioners use each metric’s CV data or simply the standard deviation attained from multiple trials or test sessions, to determine whether a meaningful change has occurred during retesting (Rebelo et al. 2026; Turner et al. 2015). As a final point of consideration, because this commentary does not suggest using thresholds which represent a fraction of the measurement error (e.g., smallest worthwhile change), retesting no sooner than 4-weeks is advised, so that sufficient time passes for some legitimate changes in physical capacity to have occurred.

Thirdly, test standardization is vital to ensure that subsequent outputs are as accurate (and reliable) as possible. Put simply, a ‘quiet standing period’ of at least 1-second on force platforms is essential prior to the jump, so that body mass can be accurately determined (Owen et al. 2014). This is relevant so that the first meaningful change in force can be computed at the right stage of

unweighting – especially when the impulse-momentum method is being used to compute how high the athlete jumps (Xu et al. 2023). As such, poor adherence to key aspects of test standardization will have a knock-on effect as to the accuracy of all subsequent metrics that the software then calculates.

Finally, it is easy to fall into the ‘collinearity trap’, whereby many of the monitored variables are actually telling us the same thing. For example, there is an argument to say that jump height, net impulse, and take-off velocity provide the same information, albeit it in different units. Specifically, impulse is the mechanistic reason why jump height is what it is – it describes the net force produced over the propulsive phase (Turner et al. 2020). Similarly, how high an athlete jumps is a product of the athlete’s take-off velocity. In essence, one of these describes how force is produced over time (impulse), one describes the product of that force production over time (take-off velocity), and the other describes the subsequent performance output (jump height). Whilst three independent metrics do exist, they are inherently linked to the final outcome of jump height; thus, there is an argument against needing all three and only focusing on one (if it is deemed appropriate).

In summary, whilst not an exhaustive list, this section outlines some of the key challenges that practitioners face when utilizing the CMJ as part of their routine testing protocols. Figure 1 provides a graphical representation of these challenges, and as long as practitioners keep these issues in mind, it will help ensure they do not fall into the trap that many have done in the past.

***** Insert Figure 1 about here *****

WHEN TO INTRODUCE COUNTERMOVEMENT JUMP TESTING

The CMJ (both bilateral and unilateral versions) require rapid eccentric and concentric actions. Thus, clinicians must consider when the appropriate time is to expose an athlete to these demands. A common approach is to use standardized time points – i.e., 3-months post-surgery (Dutaillis et al. 2025); however, this approach does not account for individual variation in tissue healing, neuromuscular recovery, and psychological readiness. In clinical practice, progression through rehabilitation phases using a criterion-based approach is regarded as best practice (Kotsifaki et al. 2023). In addition, it should be noted that evidence-based criteria to guide when to start jumping post ACL injury remains unclear. Thus, in the absence of these, it is prudent to use clinical markers of knee homeostasis, function restoration in key physical characteristics, and normative data to set benchmarks to guide progression.

First and foremost, the introduction of jump testing requires an absence of effusion (< grade 1 + on stroke test) (Sturgill et al. 2009), clinical knee stability on Lachman testing, full knee extension (or preferably hyperextension), and knee flexion ROM > 120°. It is also advised for pain to remain within manageable limits (0-3 using a numeric scale). Patient reported and objective measures of function should also be assessed. At 3-months post-surgery, self-reported International Knee Documentation Committee (IKDC), and ACL Return to Sport Index (ACL-RSI) scores of 68 ± 10 and 48 ± 25 have been reported (Dutaillis et al. 2025) and can be used as potential benchmarks.

Objective measures of movement quality, limb capacity and peak force production capability, particularly of the knee extensors, are advised before commencing with jump testing. Common literature recommendations suggest using isokinetic limb symmetry thresholds, but there are inherent limitations of ratios (Bishop 2025), and the potential for deterioration in the uninvolved limb (Wellsandt et al. 2017). Furthermore, this testing mode is also hard for many clinicians to

access. Thus, inline dynamometry provides a practically viable approach. Our experience (Read, 2025) and published data (Dutailis et al. 2025) indicate that at 3-months post-surgery, knee extension peak torque at 90°, ranges between 5.5-6.5 N/kg provide a reasonable minimum target. If no equipment is available, isotonic single leg knee extension scores of > 40-50% of body mass can be used, but this suggestion is purely anecdotal.

Moving beyond the knee, we must consider that the propulsion required to jump vertically involves predominantly equal contributions from the ankle, knee and hip (Kotsifaki et al., 2021). The soleus also contributes meaningfully during the final phase of take-off (Kotsifaki et al. 2022). Thus, it is prudent for athletes to demonstrate at least a base level of function at the ankle and hip, as well as at the knee. Clinician friendly assessments such as single leg calf raises and glute bridges (target > 25 reps) are recommended. If technology is being used, seated plantar flexion on a fixed dynamometer of > 13 N/kg provides a realistic benchmark (Read, 2025).

Movement quality should also be assessed in representative tasks before vertical jump testing is integrated. For example, the ability to perform a single leg squat (under control) to a depth > 70° is expected by 3-months post-surgery and can be used as an additional clinical benchmark (Read, 2025). When technology is available, a bilateral squat on dual force platforms can also be used with the goal of athletes displaying between-limb differences in mean braking and propulsive force of < 10% (Read, 2025). Supporting this, in our experience, athletes should be able to achieve appropriate depth ($> -34 \pm 7.3$ cm negative displacement) and display relevant intent (eccentric peak velocity -0.5 m/s or faster) (Read, 2025).

Collectively, and although some suggestions are subjective, the aforementioned section provides some clinical guidance as to when both bilateral and unilateral CMJ testing should be implemented.

SO, WHICH METRICS HOLD TRUE IN INJURY-BASED CONTEXTS?

In light of the previous section in this commentary, we can now ask ourselves which metrics are relevant for rehabilitation professionals to use from the CMJ test and why. As an additional point of consideration, this article proposes that the metrics put forward can be selected when using both the bilateral and unilateral versions of the CMJ. However, it is important to appreciate that these tests offer practitioners different information and should not be used inter-changeably. Specifically, the velocity of movement during the CMJ will be greater than the unilateral CMJ (which is why a bilateral jump height is greater than a unilateral one). In contrast, the relative force per limb will be higher during a unilateral CMJ (Cohen et al. 2020). In essence, the bilateral CMJ is likely to be more useful for understanding an athlete's compensation strategies, whilst the unilateral CMJ is likely to provide superior information relating to 'true limb capacity' – given no direct interaction from the other limb takes place. With this in mind, it seems sensible to suggest that both versions probably have their place in a testing battery, but an appreciation that these offer different pieces of information will help drive decision-making specific to both the practitioner and the context of the athlete's current physical capacity at the time of testing. Finally, whilst some injuries may dictate specific variables that need to be monitored, the underlying principles of metric reliability and the need to select measures which adequately show restoration in capacity are likely to be uniform for practitioners using jump testing during a patient's ACL rehabilitation journey. With this in mind, these are the CMJ metrics that we propose injury rehabilitation professionals prioritize, noting that jump height and all suggested force measures have been shown to elicit significant reductions in capacity, relative to the uninvolved limb after an ACL injury (Dutaillis et al. 2024):

Jump height

As the primary outcome measure from nearly all jump tests, this metric will always be relevant as it is likely to be the one that key stakeholders (i.e., the athlete and head coach) are able to understand (Bishop et al. 2023). Furthermore, jump height is consistently (and strongly) associated with independent measures of athletic performance, such as linear and change of direction speed (Smirniotou et al. 2008; Vescovi et al. 2008) and a primary distinguishing variable in the rehabilitation journey (Morris et al. 2026), which indicates that it may provide supporting information for other important physical qualities (when the athlete is ready to return to performance-focused training).

Mean propulsive force

In line with the aforementioned narrative relating to the importance of restoring deficits in physical capacity, this metric enables an understanding of how force generation capabilities have recovered during a ballistic physical test measure. Importantly, it represents a critical propulsive based metric, which serves as an important factor behind why jump height is or is not improving, when tracking change over time (Bishop et al. 2023).

Mean braking force

Given the context behind how some ACL injuries happen (i.e., too much force attenuation in a short amount of time – although other injury mechanisms also occur) (Della Villa et al. 2020; Della Villa et al. 2025), mean braking force seems an especially relevant metric. Importantly, mean force makes more sense than peak force (which is just a single instantaneous moment prior to take-off), as it provides a depiction of the average force accumulated over the entire jump. This may be especially important during rehabilitation with respect to contralateral limb function, which can also be impaired, especially during the braking actions of the CMJ (Al-Saket et al. 2026).

Countermovement depth

This measure provides practitioners with context as to why mean braking force changes, when monitoring over time (Bishop et al. 2022). Put another way, if countermovement depth decreases prior to take-off (i.e., a shallower countermovement strategy is adopted) and movement velocity is maintained, athletes will require a sharper, elevated braking force before transitioning to the upward movement of the jump. Consequently, including this metric helps to complement the information obtained from mean braking force.

Mean landing force

The landing component of a jump–landing task may provide additional information relevant to injury risk – potentially more so than propulsive–based measures (Pedley et al. 2020). Although somewhat speculative, this is likely because an athlete’s ability to attenuate force on landing is likely a closer representation of the associated injury mechanism than during take-off (Della Villa et al. 2020).

Inter-limb asymmetry

Important to note, one of the primary purposes of a rehabilitation professional’s role is to restore function and physical capacity in injured populations. Thus, quantifying any residual deficits or side-to-side asymmetries is a fundamental part of any sports injury practitioner’s role (Bettariga et al. 2022). However, at this point, the reader should note that reference to monitoring inter-limb differences relates only to the aforementioned metrics already proposed herein. With this in mind, if practitioners select the bilateral CMJ, side-to-side differences can only be quantified for force metrics – as separate left and right values for jump height and countermovement depth are not feasible. In contrast, if and when using the unilateral CMJ, inter-limb differences can be quantified for all proposed variables. Importantly though, it is suggested that practitioners do not rely on the interpretation of asymmetry measures in isolation. This is especially relevant during injury

rehabilitation given that reduced asymmetry can be evident as a consequence of reductions in the contralateral limb's physical capacity (Al-Saket et al. 2026), not just improvements in the involved limb.

***** Insert Figure 2 about here *****

CONCLUSION

In summary, selecting a test for data collection is a relatively straightforward process – especially where assessments like the CMJ are concerned. In contrast, specific metric selection is complex given the amount practitioners are able to choose from when performing jump tests on force platforms. This article proposes a pragmatic set of metrics for rehabilitation professionals to monitor when working with athlete populations who have suffered from a traumatic knee injury, such as an ACL rupture.

251 **Acknowledgments**

252 Not applicable.

253 **Disclosure**

254 The authors report that there are no competing interests to declare.

255 **Funding**

256 No funding was obtained for this study.

257 **Author Contributions**

258 Chris Bishop conceptualized the article and wrote all drafts.

259 All other authors contributed equally to this manuscript with reading and editing duties and all
260 authors have agreed to the final submitted draft.

261 **Data Availability**

262 Not applicable.

263 **Declaration of generative AI use**

264 Generative AI tools (ChatGPT and Genspark) were used to help create Figures 1 and 2.

REFERENCES

- Al-Saket S, McClean Z, Mossel NB, Botha T, Bayne H, De França C, Pasanen K and Jordan M. 2026. Stretch-shortening cycle force–time and power–time waveform analysis indicates limitations of the contralateral limb benchmark in athletes with ACL injury. *Knee Surgery, Sports Traumatology, Arthroscopy* (published ahead of print). <https://doi.org/10.1002/ksa.70443>
- Barber SD, Noyes FR, Mangine RE, McColskey JW and Hartman W. 1990. Quantitative assessment of functional limitations in normal and anterior cruciate ligament-deficient knees. *Clinical Orthopaedics and Related Research* 255: 204–214.
- Bettariga F, Turner A, Maloney S, Maestroni L, Jarvis P and Bishop C. 2022. The Effects of Training Interventions on Interlimb Asymmetries: A Systematic Review with Meta-analysis. *Strength and Conditioning Journal* 44: 69-86.
- Bishop C. 2025. Using ratio data in strength and conditioning: Component parts hold the key. *Journal of Strength and Conditioning Research* 39: e176-e179.
- Bishop C, Jordan M, Torres-Ronda L, Loturco I, Harry J, Virgile A, Mundy P, Turner A and Comfort P. 2023. Selecting Metrics That Matter: Comparing the Use of the Countermovement Jump for Performance Profiling, Neuromuscular Fatigue Monitoring, and Injury Rehabilitation Testing. *Strength and Conditioning Journal* 45: 545-553.
- Bishop C, Turner A, Jordan M, Harry J, Loturco I, Lake J and Comfort P. 2022. A Framework to Guide Practitioners for Selecting Metrics During the Countermovement and Drop Jump Tests. *Strength and Conditioning Journal* 44: 95-103.
- Claudino JG, Cronin J, Mezencio B, McMaster D, McGuigan M, Tricoli V, Amadio A and Serrao J. 2017. The counter movement jump to monitor neuromuscular status: A meta-

288 analysis. Journal of Science and Medicine in Sport 20: 397-402.

289 Cohen D, Burton A, Wells C, Taberner M, Diaz M, and Graham-Smith P. 2020. Single

290 vs. double leg countermovement jumps: Not half an apple! Aspetar Sports Medicine Journal

291 Special Issue: 34-41.

292 Cormack SJ, Newton RU, McGuigan M and Doyle T. 2008. Reliability of Measures

293 Obtained During Single and Repeated Countermovement Jumps. International Journal of Sports

294 Physiology and Performance 3: 131-144.

295 Della Villa F, Buckthorpe M, Grassi M, Nabiuzzi A, Tosarelli F, Zaffagnini S and Della

296 Villa S. 2020. Systematic video analysis of ACL injuries in professional male football (soccer):

297 injury mechanisms, situational patterns and biomechanics study on 134 consecutive cases.

298 British Journal of Sports Medicine 54: 1423-143.

299 Della Villa F, Stride M, Bortolami A, Williams A, Davison M and Buckthorpe M. 2025.

300 Systematic Video Analysis of ACL Injuries in Male Professional English Soccer Players: A

301 Study of 124 Cases. Orthopaedic Journal of Sports Medicine 13: 1-14.

302 <https://doi.org/10.1177/23259671251314642>

303 Dutailis B, Collings T, Bellinger P, Timmins R, Williams M and Bourne M. 2025. Time-

304 course changes in lower limb strength, vertical jump metrics and their relationship with patient

305 reported outcomes following anterior cruciate ligament reconstruction. Knee Surgery, Sports

306 Traumatology, Arthroscopy 33: 2684-2699.

307 Dutailis B, Diamond L, Lazarczuk S, Timmins R and Bourne M. 2024. Vertical Jump

308 Testing Following Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-

309 analysis. Medicine & Science in Sports & Exercise 56: 181-192.

310 Fort-Vanmeerhaeghe A, Mila-Villaruel R, Pujol-Marzo M, Arboix-Alio J and Bishop C.

2022. Higher Vertical Jumping Asymmetries and Lower Physical Performance are Indicators of Increased Injury Incidence in Youth Team-Sport Athletes. *Journal of Strength and Conditioning Research* 36: 2204-2211.

Grindem H, Logerstedt D, Eitzen I, Moksnes H, Axe MJ, Snyder-Mackler L, Engebretsen L and Risberg, M. 2011. Single-legged hop tests as predictors of self-reported knee function in nonoperatively treated individuals with anterior cruciate ligament injury. *American Journal of Sports Medicine* 39: 2347–2354.

Jordan MJ, Aagaard P and Herzog W. 2015. Lower limb asymmetry in mechanical muscle function: A comparison between ski racers with and without ACL reconstruction. *Scandinavian Journal of Medicine & Science in Sports* 25: e301–e309.

<https://doi.org/10.1111/sms.12314>

Kotsifaki A, Korakakis V, Graham-Smith P, Sideris V and Whiteley R. 2021. Vertical and horizontal hop performance: Contributions of the hip, knee, and ankle. *Sports Health* 13: 128-135.

Kotsifaki R, Korakakis V, King E, Barbosa O, Maree D, Pantouveris M, ... and Whiteley R. 2023. Aspetar clinical practice guideline on rehabilitation after anterior cruciate ligament reconstruction. *British Journal of Sports Medicine* 57: 500-514.

Kotsifaki A, Korakakis V, Whiteley R, Van Rossom S and Jonkers I. 2020. Measuring only hop distance during single leg hop testing is insufficient to detect deficits in knee function after ACL reconstruction: a systematic review and meta-analysis. *British Journal of Sports Medicine* 54: 139-153.

Kotsifaki A, Van Rossom S, Whiteley R, Korakakis V, Bahr R, Sideris V and Jonkers I. 2022. Single leg vertical jump performance identifies knee function deficits at return to sport

334 after ACL reconstruction in male athletes. British Journal of Sports Medicine 56: 490-498.

335 Lloyd RS, Oliver JL, Kember LS, Myer GD and Read PJ. 2020. Individual hop analysis
336 and reactive strength ratios provide better discrimination of ACL reconstructed limb deficits than
337 triple hop for distance scores in athletes returning to sport. The Knee 27: 1357-1364.

338 Losciale JM, Bullock G, Cromwell C, Ledbetter L, Pietrosimone L and Sell TC. 2020.
339 Hop testing lacks strong association with key outcome variables after primary anterior cruciate
340 ligament reconstruction: a systematic review. American Journal of Sports Medicine 48: 511-522.

341 Morris N, Torres RS, Heard M, Baker PD, Herzog W and Jordan MJ. 2026.
342 Countermovement Jump Force-Time Mechanics Differentiate ACL Injury Status in Elite Alpine
343 Ski Racers. Scandinavian Journal of Medicine & Science in Sports 36: e70270.
344 <https://doi.org/10.1111/sms.70270>

345 Noyes FR, Barber SD and Mangine RE. 1991. Abnormal lower limb symmetry is
346 determined by function hop tests after anterior cruciate ligament rupture. The American Journal
347 of Sports Medicine 19: 513-518.

348 Owen N, Watkins J, Kilduff L, Bevan H and Bennett M. 2014. Development of a
349 Criterion Method to Determine Peak Mechanical Power Output in a Countermovement Jump.
350 Journal of Strength and Conditioning Research 28: 1552-1558.

351 Pedley JS, Lloyd RS, Read P, Moore IS, De Ste Croix M, Myer G and Oliver J. 2020.
352 Utility of Kinetic and Kinematic Jumping and Landing Variables as Predictors of Injury Risk: A
353 Systematic Review. Journal of Science in Sport and Exercise 2: 287-304.

354 Read P. 2025. Practitioners Guide to ACL. A comprehensive guide for practitioners
355 leveraging technology to optimize anterior cruciate ligament recovery and return-to-performance
356 planning. Vald Performance.

357 Rebelo A, Bishop C, Thorpe R, Turner A and Gabbett T. 2026. Monitoring Training
 358 Effects in Athletes: A Multidimensional Framework for Decision-Making. *Sports Medicine* 56:
 359 1603-1624.

360 Rohman E, Steubs JT and Tompkins M. 2015. Changes in involved and uninvolved limb
 361 function during rehabilitation after anterior cruciate ligament reconstruction: Implications for
 362 limb symmetry index measures. *American Journal of Sports Medicine* 43: 1391–1398.

363 Smirniotou A, Katsikas C, Paradisis G, Argeitaki P, Zacharogiannis E and Tziortzis S.
 364 2008. Strength-power parameters as predictors of sprinting performance. *Journal of Sports*
 365 *Medicine and Physical Fitness* 48: 447-454.

366 Sturgill L, Snyder-Mackler L, Manal T and Axe M. 2009. Interrater reliability of a
 367 clinical scale to assess knee joint effusion. *Journal of Orthopaedic & Sports Physical Therapy* 39:
 368 845-849.

369 Turner A, Brazier J, Bishop C, Chavda S, Cree J and Read P. 2015. Data Analysis for
 370 Strength and Conditioning Coaches: Using Excel to Analyze Reliability, Differences, and
 371 Relationships. *Strength and Conditioning Journal* 37: 76-83.

372 Turner A, Comfort P, McMahon J, Bishop C, Chavda S, Read P, Mundy P and Lake J.
 373 2020. Developing Powerful Athletes, Part 1: Mechanical Underpinnings. *Strength and*
 374 *Conditioning Journal* 42: 30-39.

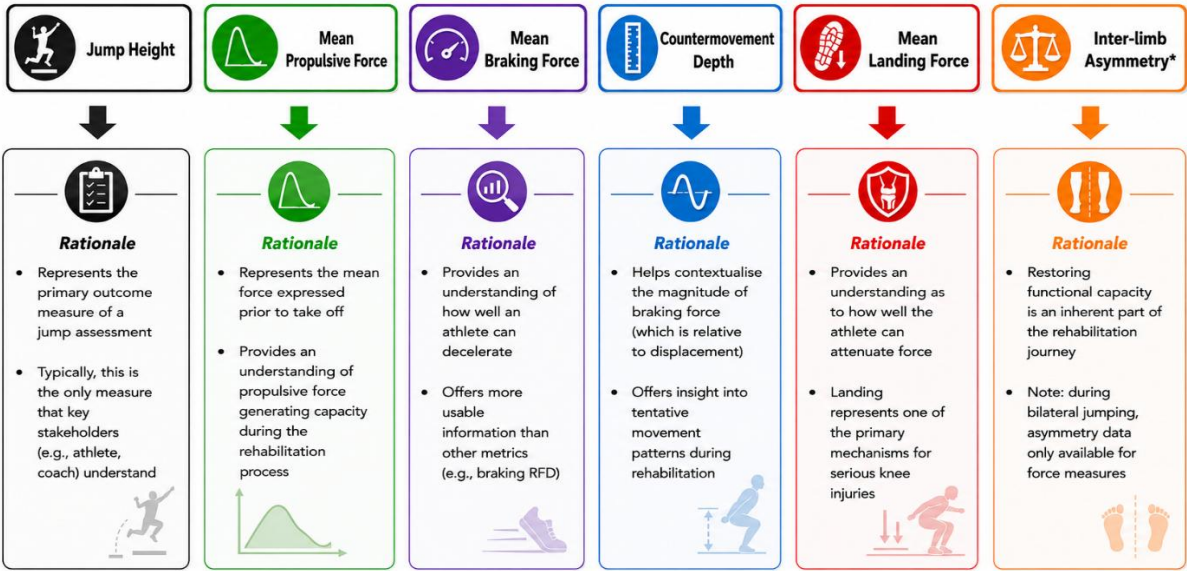
375 Vescovi J and McGuigan M. 2008. Relationships between sprinting, agility, and jump
 376 ability in female athletes. *Journal of Sports Sciences* 26: 97-107.

377 Wellsandt E, Failla M, and Snyder-Mackler L. 2017. Limb symmetry indexes can
 378 overestimate knee function after anterior cruciate ligament injury. *Journal of Orthopaedic &*
 379 *Sports Physical Therapy* 47: 334-338.

380 Xu J, Turner A, Comfort P, Harry J, McMahon J, Chavda S and Bishop C. 2023. A
381 Systematic Review of the Different Calculation Methods for Measuring Jump Height During the
382 Countermovement and Drop Jump Tests. Sports Medicine 53: 1055-1072.



Figure 1. Key challenges for practitioners when using the bilateral and unilateral countermovement jump assessments on force platforms.



388

389

Figure 2. Suggested metrics for the rehabilitation professional to prioritize when using the countermovement jump (CMJ) during routine testing protocols for injured populations.

390

391

*Note: * indicates that inter-limb asymmetry can only be measured for the raw metrics of mean*

392

propulsive force, mean braking force and mean landing force during the bilateral CMJ and for

393

all metrics if the unilateral CMJ is selected.