CERITER

Stride One in Post-Operative Recovery:

Early Progressive Weight Bearing for Lower-Limb Fractures

It is estimated that in 2019, 436 million people worldwide were living with fractures and associated problems in functioning that could benefit from rehabilitation[1]. The top three anatomical sites of fracture in terms of number of years lived with disability (YLDs) and age-standardized YLD rates are fracture of the lower limb (patella, tibia or fibula, or ankle); pelvis; and hip[2].

An increase in life expectancy will lead to a concurrent increase in the proportion of elderly individuals in the population, and consequently to a rise in the incidence of hip fractures. The number of hip fractures is expected to increase to about 4.5 million per year worldwide by 2050. Even with successful surgery, the mortality and the risk of permanent disability and dependence remain high in patients with hip fractures. As a result, medical costs associated with the treatment of these patients are increasing.

For these reasons, hip fractures are an increasingly important global public health issue[3]. Hip fractures in older patients are one of the most common injuries; in the USA alone, hip fracture cases represent around 30% of all hospitalized cases[4].

Progressive weight-bearing after a fracture can be an effective strategy for promoting healing and functional recovery, but its implementation requires careful consideration of individual patient factors and fracture characteristics. Early, controlled weight-bearing can stimulate bone healing and improve functional outcomes, while excessive or premature weight-bearing can delay healing or lead to complications.

Weight-bearing may be limited in order to modulate the strain environment of a fracture as it heals, to protect soft tissues or to ensure construct safety. However, advancing a patient's weight-bearing status is preferably done as quickly as possible in order to minimize tissue atrophy and disuse osteopenia and maximize functional recovery[5,6].

References:

1. Cieza A, Causey K, Kamenov K, Wulf Hanson S, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease Study 2019: a systematic analysis. Lancet. 2021;396(10267):2006–17.
2. GBD 2019 Fracture Collaborators. Global, regional, and national burden of bone fractures in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet Healthy Longev. 2021;2(9):e580–92.
3. Lee K, Um S, Kim Y. Postoperative rehabilitation after hip fracture: a literature review. Hip Pelvis. 2020;32(3):125–31.
4. Abdalbary SA. Partial weight bearing in hip fracture rehabilitation. Future Sci OA. 2017;4(1):FSO254. doi:10.4155/fsoa-2017-0085.
5. Kubiak EN, Beebe MJ, North K, Hitchcock R, Potter MQ. Early weight bearing after lower extremity fractures in adults. J Am Acad Orthop Surg. 2013;21(12):727–38.
6. Dong W, Lisitano LSJ, Marchand LS, Reider LM, Haller JM. Weight-bearing guidelines for common geriatric upper and lower extremity fractures. Curr Osteoporos Rep. 2023;21(6):698–709.

CERITER

The role of Early and Progressive Weight-Bearing (EPWB)

EPWB can prevent **prolonged periods of bedriddenness** and **reduce the loss of muscle strength** within the first postoperative weeks in the fractured limb. This is on average more than 50% compared with the non-fractured limb, especially for those with trochanteric fractures[7,8,9].

EPWB and mobilization **is safe for a variety of fractures** such as intra- and peri-articular fractures, femoral, tibial plateau (after internal fixation with subchondral screws and a buttress plate), tibia plafond, ankle, and calcaneal fractures. No increase in complication rate was found compared to usual care with time-contingent weight bearing[10,11,12,13,14,15,16,26].

In a larger literature study on 4918 elderly patients with a fracture of the hip it was found that postoperative weight-bearing restrictions even led to a significantly greater risk of developing more adverse events compared with those who are encouraged to start bearing weight[17].

Early (within 2 weeks) weight bearing-exercises after hip and tibial fracture surgery result in significant reduction of non-union, avascular necrosis and mortality over 1 and 3 years[18,19].

References:

7. Kristensen MT, Bandholm T, Bencke J, Ekdahl C, Kehlet H. Knee-extension strength, postural control and function are related to fracture type and thigh edema in patients with hip fracture. Clin Biomech (Bristol, Avon). 2009;24(3):218–24.
8. Lamb SE, Morse RE, Evans JG. Mobility after proximal femoral fracture: the relevance of leg extensor power, postural sway and other factors. Age Ageing. 1995;24(4):308–14.
9. Sherrington C, Lord SR, Herbert RD. A randomised trial of weight-bearing versus non-weight-bearing exercise for improving physical ability in inpatients after hip fracture. Aust J Physiother. 2003;49(1):15–22.
10. Haller JM, Potter MQ, Kubiak EN. Weight bearing after a periarticular fracture: what is the evidence? Orthop Clin North Am. 2013;44(4):509–19.
11. Smeeing DP, Houwert RM, Briet JP, et al. Weight-bearing and mobilization in the postoperative care of ankle fractures: a systematic review and meta-analysis of randomized controlled trials and cohort studies. PLoS One. 2015;10(2):e0118320.
12. Solomon LB, Callary SA, Stevenson AW, et al. Weight-bearing-induced displacement and migration over time of fracture fragments following split depression fractures of the lateral tibial plateau: a case series with radiostereometric analysis. J Bone Joint Surg Br. 2011;93(6):817–23.
13. Kalmet P, Maduro C, Verstappen C, Meys G, van Horn Y, van Vugt R, et al. Effectiveness of permissive weight bearing in surgically treated trauma patients with peri- and intra-articular fractures of the lower extremities: a prospective comparative multicenter cohort study. Eur J Orthop Surg Traumatol. 2024;34(3):1363–71.
14. Flowers DW, McCallister E, Christopherson R, Ware E. The safety and effectiveness of early, progressive weight bearing and implant choice after traumatic lower extremity fracture: a systematic review. Bioengineering (Basel). 2022;9(12):750.
15. Graham J. Early or delayed weight-bearing after internal fixation of transcervical fracture of the femur: a clinical trial. J Bone Joint Surg Br. 1968;50(3):562–9.
16. Lin CWC, Donkers NAJ, Refshauge KM, Beckenkamp PR, Khera K, Moseley AM. Rehabilitation for ankle fractures in adults. Cochrane Database Syst Rev. 2012;11:CD005595.
17. Ottesen TD, McLynn RP, Galivanche AR, et al. Increased complications in geriatric patients with a fracture of the hip whose postoperative weight-bearing is restricted: an analysis of 4918 patients. Bone Joint J. 2018;100-B(10):1377–80.
18. Handoll HHG, Sherrington C, Mak JCS. Interventions for improving mobility after hip fracture surgery in adults. Cochrane Database of Systematic Reviews 2011, Issue 3.
19. Weng S., Bi C., Gu S., Qi X., Huang Y. Immediate weightbearing after intramedullary fixation of extra-articular distal tibial fractures reduces the nonunion rate compared with traditional weight-bearing protocol: A cohort study. Int. J. Surg. 2020;76:132–135.

CERITER

The role of Early and Progressive Weight-Bearing (EPWB)

Early weight-bearing after surgery for ankle fracture does not increase the re-operation risk[20] and reduces the risk of deep venous thrombosis[21].

In terms of infection after open reduction and internal fixation of unstable ankle fractures, no statistically significant difference between the early weight-bearing group and the late weight-bearing group is found[22].

Several significant **improved health outcomes** have been demonstrated when managing fractures of the lower limb with EPWB compared to late, time-restraint weight bearing, such as better walking speed, mobility, level of daily activities, functional recovery, return to work, and Quality of Life[11,13,14,15,16,21,23,24].

EPWB **enhances the rehabilitation program** for fractures of the lower limb with a quicker bone healing time, reduced time to full weight bearing (time to full weight bearing from 20 to 15 weeks), higher patient satisfaction, less pain, shorter hospital stays, discharge to home and less discharge to high-level care[13,14,20,21,23,25,26,27].

EPWB reduces expenses and is cost saving for every improvement in functioning (measured with the Lower Extremity Functional Scale)[13,26].

References:

20. Lewis SR, Pritchard MW, Parker R, Searle HKC, Beckenkamp PR, Keene DJ, Bretherton C, Lin CC. Rehabilitation for ankle fractures in adults. Cochrane Database Syst Rev. 2024 Sep 23;9(9).
21. Richtlijnen Enkelfracturen 2017 van het Nederlands Kennisinstituut van de Federatie van Medische Specialisten
22. Dehghan N., McKee M.D., Jenkinson R.J., Schemitsch E.H., Stas V., Nauth A., Hall J.A., Stephen D.J., Kreder H.J. Early weightbearing and range of motion versus non-weightbearing and immobilization after open reduction and internal fixation of unstable ankle fractures: A randomized controlled trial. J. Orthop. Trauma. 2016;30:345–352.
23. Oldmeadow LB, Edwards ER, Kimmel LA, Kipen E, Robertson VJ, Bailey MJ. No rest for the wounded: early ambulation after hip surgery accelerates recovery. ANZ J Surg 2006;76:607-611.
[24. Fairhall NJ, Dyer SM, Mak JC, Diong J, Kwok WS, Sherrington C. Interventions for improving mobility after hip fracture surgery in adults. Cochrane Database Syst Rev. 2022 Sep 7;9(9):CD001704.
25. Yang Q, Yang H, Zhao J, Ren L. Enhanced Recovery After Surgery (ERAS) Rehabilitation Protocols Significantly Improve Postoperative Pain and Recovery in Ankle Fracture Surgery. Ther Clin Risk Manag. 2025 Jun 5;21:841-850.
26. Tao J, Yan Z, Bai G, Zhang H, Li J. Enhanced Recovery after Surgery Rehabilitation Protocol in the Perioperative Period of Orthopedics: A Systematic Review. J Pers Med. 2023 Feb 26;13(3):421.
27. Weng S., Bi C., Gu S., Qi X., Huang Y. Immediate weightbearing after intramedullary fixation of extra-articular distal tibial fractures reduces the nonunion rate compared with traditional weight-bearing protocol: A cohort study. Int. J. Surg. 2020;76:132–135.

CERITER

Current Practice

Several circumstances give rise to a wide range of weight bearing patterns and inconsistent rehabilitation after surgery for peri- or intra-articular fractures of the lower extremity.

Currently, a **lack of standardization** exists regarding EPWB protocols and weight-bearing doses or clinical decision-making used to progress weight bearing[14]. In view of a lack of evidence, many orthopedic and trauma surgeons tend to advise conservatively with regard to weight bearing in rehabilitation after the surgical management of peri- or intra-articular fractures of the lower extremity, and hold on to the prevailing dogmas, i.e. recommending time-contingent progression of weight bearing[28,29] .

A gap exists between the basic **scientific knowledge** concerning the benefit of progressive loading of injured bone and **clinical practice**. This gap presents an opportunity to improve the rehabilitation process through staged and sequential loading for optimal outcomes. Little research has reported on progression of weight bearing and no study details a controlled progression of weight-bearing status. Hence, there is little helpful information for enhancing the rehabilitation professional's clinical decision-making[14].

Many studies use weight bearing "as tolerated" with signs and symptoms of potential complications (such as pain) as the only clinical benchmark (also called permissive WB)[14].

The lack of individual feedback on the actual weight bearing status causes great differences in weight bearing when the patient is advised restricted weight bearing[30,31,32].

References:

28.Thomas P, Ruedi RE, Buckley CG, Moran. AO Principles of Fracture Management. Thieme, New York. 2007.
29.Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty for osteoarthritis: a focus group study. BMC Health
Serv Res. 2010;10:119-33.
30. Gray FB, Gray C, McClanahan JW. Assessing the accuracy of partial weight-bearing instruction. Am J Orthop (Belle Mead NJ).1998;27:558-60.
[31.Hurkmans HL, Bussmann JB, Selles RW et al. The difference between actual and prescribed weight bearing of total hip patients with a trochanteric osteotomy: long-term vertical force measurements
inside and outside the hospital. Arch Phys Med Rehabil. 2007;88:200-6.
32.Hustedt JW, Blizzard DJ, Baumgaertner MR et al. Is it possible to train patients to limit weight bearing on a lower extremity? Orthopedics. 2012;35:e31-7.

CERITER

Current Practice

Studies reported that one third of the patients do not comply with a non- or restricted weight bearing regimen and patients exceed the prescribed amount of partial weight bearing even when self-reported compliance was high[32,33]. Multiple published studies have shown high non-compliance rates with weight-bearing prescriptions[34,35,36].

A study concluded that partial weight bearing could not accurately be reproduced with any of the weight-bearing techniques that are currently applied, which was supported by previous evidence showing an inability to accurately reproduce partial weight-bearing orders[4][21].

Despite physical therapy training, weight-bearing compliance to recommended limits is low during the post-operative aftercare after ankle, tibial shaft and intertrochanteric femur fractures. Adherence to the partial weight-bearing task even further decreases over time[35]. Only one in 10 patients completely adheres to the set weight bearing limit[38].

A substantial economic burden has been demonstrated in monetary terms and effect on Quality of Life of patients with peri- and/or intra-articular fractures of the lower extremities managed with non-weight bearing for 6-12 weeks, followed by partial weight bearing with a 25% increase in fracture loading every week during 26 weeks follow-up[39].

References:

33. de Boer AS, van Lieshout EMM, van Moolenbroek G et al. The effect of time to post-operative weightbearing on functional and clinical outcomes in adults with a displaced intra-articular calcaneal fracture; A systematic review and pooled analysis. Injury. 2018;49:743-52.
34. Chiodo CP, Macaulay AA, Palms DA, Smith JT, Bluman EM. Patient compliance with postoperative lower-extremity non-weight-bearing restrictions. J Bone Joint Surg Am. 016;98(18):1563–1567.
35. Braun B, Veith N, Rollmann M, et al. Weight-bearing recommendations after operative fracture treatment-fact or fiction? Gait results with and feasibility of a dynamic, continuous pedobarography insole. Int Orthop. 2017;41(8):1507–1512.
36. Dabke HV, Gupta SK, Holt CA, O'Callaghan P, Dent CM. How accurate is partial weightbearing? Clin Orthop Relat Res. 2004;421(421):282.
37. Yu S, McDonald T, Jesudason C, Stiller K, Sullivan T. Orthopedic inpatients' ability to accurately reproduce partial weight bearing orders. Orthopedics. 2014;37(1):e10–e18.
38. Braun BJ, Bushuven E, Hell R, Veith NT, Buschbaum J, Holstein JH, Pohlemann T. A novel tool for continuous fracture aftercare - Clinical feasibility and first results of a new telemetric gait analysis insole. Injury. 2016 Feb;47(2):490-4.
39. PHS Kalmet, MT Andriessen, CV Maduro, N van den Boom, CPA Moens-Oyen, M Hiligsmann, H Janzing, A van der Veen, C Jaspars, JB Sintenie, HAM Seelen, PRG Brink, M Poeze, SMAA Evers. The economic burden of the postoperative management in surgically treated trauma patients with peri- and/or intra-articular fractures of the lower extremities: A prospective multicenter cohort study, Injury, Volume 53, Issue 2, 2022, Pages 713-718.

CERITER

The Potential of Real-Time Biofeedback on Weight Bearing Loads

WHO recommends progressive weight-bearing exercises in people with fractures in the lower extremity, including the use of a weight scaling[40]. However, since the ability of patients to produce partial weight bearing is attached to their **ability to reproduce partial weight-bearing orders**[41], a real-time biofeedback on weight bearing loads is crucial.

There is evidence that feedback or stimulation based on sound or noise is beneficial[42]. Providing the adequate level of weight bearing on the fracture in a timely fashion during early aftercare treatment is essential in the speed towards full mobilization. Both over-loading and under-loading may lead to a prolonged and complicated recovery[43,44,45].

A smart insole with real-time biofeedback on weight bearing levels has the potential to finetune and fully **accommodate this balance that has to be kept between over-loading and under-loading**.

A smart insole for remote monitoring of the patient's weight-bearing loads and providing real-time feedback for non-compliant weight-bearing demonstrated **high reliability** and excellent agreement with a force plate[46]. Advanced sensor technologies used in a biofeedback system have shown highly accurate measurements, especially in the static situation[47].

Real-time audio-visual biofeedback significantly enhances compliance with weight-bearing instructions in PWB training (88% compliance in the biofeedback group compared to 19% compliance in group with standard care using a bathroom scale) while reducing the training duration with 25%. Based on these findings, the implementation of biofeedback devices in PWB training is recommended[42,48,49].

Uncontrolled weight-bearing recommendations should be viewed with caution and carefully considered as fiction. A smart insole is able to determine weight bearing continuously and immediately helps to define real-time patient behavior and establish realistic, individual weight-bearing recommendations[35].

References:

40. Package of interventions for rehabilitation. Module 2. Musculoskeletal conditions. Geneva: World Health Organization; 2023. Accessed 16 July 2025.
41. Abdalbary SA. Partial weight bearing in hip fracture rehabilitation. Future Sci OA. 2017 Oct 12;4(1):FSO254.42.
42. Franco-de La Torre L., Villafán-Bernal J.R., Garmendia-Castañón R., Franco-González A.P., Isiordia-Espinoza M.A., Alcalá-Zermeño J.L., Gómez-Sánchez E., Rodríguez-Méndez L.M., Sánchez-Enríquez S. Combination of noise plus weight-bearing accelerates consolidation time in tibial shaft fractures: A preliminary report. Cir. Cir. 2019;87:18–22.
43. Oldmeadow LB, Edwards ER, Kimmel LA et al. No rest for the wounded: early ambulation after hip surgery accelerates recovery. ANZ J Surg. 2006;76:607-11.
44. Augat P, Simon U, Liedert A, Claes L. Mechanics and mechano-biology of fracture healing in normal and osteoporotic bone. Osteoporos Int. 2005;16:S36-43.
45. Westerman RW, Hull P, Hendry RG, Cooper J. The physiological cost of restricted weight bearing. Injury. 2008;39:725-7.
46. E.E. Avcı, G. Akgün, M.E. Uygur et al., Improving partial weight bearing compliance with a smart insole: Validity, reliability, and feasibility study, Foot and Ankle Surgery.
47. M. Raaben, H.R. Holtslag, R. Augustine, R.O. van Merkerk, B.F.J.M. Koopman, T.J. Blokhuis. Technical Aspects and Validation of a New Biofeedback System for Measuring Lower Limb Loading in the Dynamic Situation. Sensors, March 2017, Volume 17, Issue 3, pp 658.
48. Lisitano L, DaSilva ZH, Koch N, Dong W, Thorne T, Röttinger T, Pfeufer D, Haller J. The Impact of Real-Time Biofeedback on Partial Weightbearing Training: A Comparative Study. Int J Sports Phys Ther. 2025 Mar 1;20(3):364-372.
49. M. Raaben, H.R. Holtslag, L.P.H. Leenen, R. Augustine, T.J. Blokhuis. Real-time visual biofeedback during weight bearing improves therapy compliance in patients following lower extremity fractures
Gait & Posture, January 2018, Volume 59, pp 206-210

CERITER

The Potential of Real-Time Biofeedback on Weight Bearing Loads

Control of postoperative pain is a vital part of rehabilitation for ensuring patient safety[41]. Safe and gradual weight-bearing is essential for pain management, restoring strength, balance and mobility, and normalizing walking patterns[50,51].

The use of biofeedback devices supports weight-bearing instructions. Smart steps and biofeedback devices provide real-time feedback enabling the therapist to determine the level of weight bearing that can be applied for the patient in an accurate way, as well as safely increasing the weight-bearing load[52].

Measures of loading distribution patterns with a smart insole could inform **EPWB protocols.** Underfoot loading distribution patterns, particularly on the medial surface of the foot, have been demonstrated to predict fracture healing time in people with lower extremity fractures[53].

Significant differences in time to painless full weight bearing between high and low performers were shown. Early gait analysis is able to define aftercare performers with significant differences in time to full painless weight bearing where clinical or radiographic controls could not[38].

As fracture care continues to evolve, we expect external weight-bearing monitoring devices to play a key role in **data collection and monitoring** of patient compliance. With reduced costs and increasing system resolution over time, the accessibility of these devices should improve.

Once the ideal parameters for weight-bearing following lower extremity fracture are elucidated, there may be a role for such devices to provide real-time feedback to the patient on their compliance[54].

References:

50. Al-Amri, M. N., et al. (2015). Complications After Hip Nailing for Fractures. Journal of Orthopaedic Trauma, 29(12), e475–e481.
51.Raleigh Surgery Center. Comprehensive Guide to Hip Fracture Surgery Recovery. https://www.raleighsurgerycenter.com/uncategorized/comprehensive-guide-hip-fracture-surgery-recovery/
52. Manguire C, Sieben JM, Scheidhauer H, Romkes J, Suica Z, de Bie RA. The effect of crutches, an orthosis TheraTogs and no walking aids on the recovery of gait in patient with delayed healing post hip fracture: a case report. Physiother. Theory Pract. 2016;32(1):69–81.
53. North K, Simpson G, Geiger W, Cizik A, Rothberg D, Hitchcock R. Predicting the Healing of Lower Extremity Fractures Using Wearable Ground Reaction Force Sensors and Machine Learning. Sensors (Basel). 2024 Aug 17;24(16):5321.
54. Robinson J, Wang AWT, Stockton DJ. Weight-Bearing Monitoring Devices in Lower Extremity Fractures: A Scoping Review. Orthop Res Rev. 2025;17:257-267

CERITER

The Application of Stride One for Selected Health Conditions

Currently, in people with **tibial plateau fracture** managed with ORIF a prolonged non-weight bearing protocol is often prescribed resulting in an increased risk of postoperative knee stiffness, nonunion or malunion, Range of Motion limitations, muscle atrophy and pain. Significant functional improvements such as better walking capacity and pain reduction are seen with early weight-bearing but surgeons and rehabilitation teams need tools for careful weight-bearing management[55,56,57,58].

Stride One's precise audio feedback ensures safe and controlled progressive loading, critical for fracture healing and preventing re-injury. This may include the reduction of the non-weight bearing period with earlier mobilization based on reliable parameters. Visual feedback on correct movement and loading encourages patients to adhere to weight-bearing protocols, crucial for optimal healing. Real-time gait analysis helps identify and correct abnormal patterns, facilitating a quicker return to a normalized gait.

Currently, in people with **periprosthetic fracture fixation** (in the lower extremity) highly individualized, prolonged NWB/PWB, followed by very gradual progression to full weight-bearing is often required. Refracture can occur in multimorbid patients[59,60]. Extensive gait retraining with assistive devices is needed. This requires complex planning, rapid mobilization, and a precise weight-bearing control.

Stride One's real-time feedback is critical for managing the restricted WB protocols and ensuring safe, gradual loading on the compromised limb. A reduction of NWB periods is possible according to patient characteristics and surgery types. Objective analysis helps correct complex gait deviations and compensatory patterns resulting from prolonged immobilization and altered biomechanics. Objective progress tracking and motivational feedback are invaluable during the very long and challenging recovery periods. By ensuring proper loading and movement, Stride One can help prevent nonunion or malunion, re-fracture, or further implant loosening.

References:

55. Tibial Plateau Fractures. https://www.orthobullets.com/trauma/1044/tibial-plateau-fractures
56. Chahla, J. (2025). Tibial Plateau Fracture ORIF Post-Op PT Protocol. https://www.jorgechahlamd.com/wp-content/uploads/2025/04/Tibial-Plateau-Fracture-ORIF-Post-Op-PT-Protocol.pdf
57. Al-Shami, A. A., et al. (2025). Immediate weight-bearing after tibial plateau fractures internal fixation results in better clinical outcomes with similar radiological outcomes: a randomized clinical trial. International Orthopaedics, 49(5), 1145–1154
58. Al-Amri, M. N., et al. (2022). A New Approach to Surgical Management of Tibial Plateau Fractures. Journal of Clinical Medicine, 11(3), 626
59. THA/TKA Periprosthetic Fracture. https://www.orthobullets.com/recon/5013/tha-periprosthetic-fracture
60. Zeman, K., et al. (2016). Periprosthetic fractures of the upper and lower extremities not only represent a challenge for surgeons but also for the rehabilitation team. Der Unfallchirurg, 119(3), 209–216

CERITER

The Application of Stride One for Selected Health Conditions

In people with an **Open Reduction Internal Fixation (ORIF)** of the ankle prolonged non-weight bearing is often required but may result in non-healing, challenges with full pain-free Range of Motion, residual ankle pain, strength deficits and impaired proprioception. Surgeons need tools for safe and progressive early mobilization and weight-bearing management[61,62,63].

Stride One's precise weight-bearing feedback ensures safe and controlled loading, critical for fracture healing and preventing re-injury. This may include the reduction of the non-weight bearing period with earlier mobilization based on reliable parameters. Real-time gait analysis helps identify and correct abnormal patterns, facilitating a quicker return to a normalized gait. Biofeedback-guided balance exercises enhance joint awareness and proprioception. Stride One provides quantitative data on weight-bearing, gait parameters, and functional strength, enabling surgeons to make data-driven decisions on progression and return to activity.

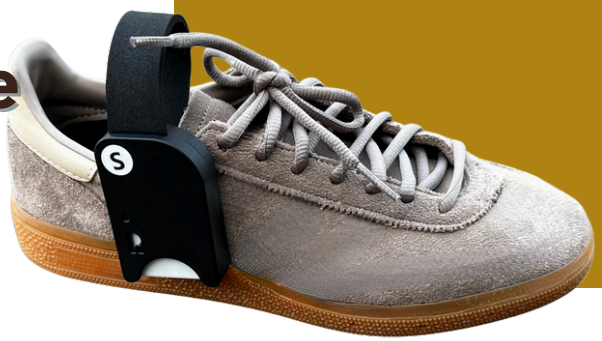
In people managed with **High Tibial Osteotomy (HTO) / Distal Femoral Osteotomy (DFO)** often prolonged NWB/PWB followed by gradual progression is needed, and extensive gait retraining once weight-bearing is allowed. However, malunion or nonunion (1-3%), incomplete correction and a lack of knee Range of Motion (extension) may occur; safe weight-bearing biofeedback training may reduce a prolonged non-weight-bearing period and risk of reoperation[64,45,66].

Stride One's precise feedback is invaluable for managing the critical NWB/PWB phases and ensuring safe, progressive loading. Real-time gait analysis helps correct complex gait deviations and compensatory patterns developed after prolonged immobilization and new alignment. Long recovery periods benefit greatly from objective progress tracking and motivational feedback.

References:

61. Ankle Fracture Open Reduction and Internal Fixation. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/ankle-fracture-open-reduction-and-internal-fixation
62. Ankle Fracture ORIF Rehab Protocol. https://stcharleshealthcare.org
63. Alam, M. S., et al. (2024). Patient-Reported Outcomes of Operatively Treated Ankle Fractures and Complication Rate in Resource-Limited Setting: A Four-years Retrospective Study. Journal of Clinical Orthopaedics and Trauma, 55, 102715.
64. Wheeless' Textbook of Orthopaedics. Complications of High Tibial Osteotomy. https://www.wheelessonline.com/bones/complications-of-high-tibial-osteotomy/
65. Mass General Brigham. Rehabilitation Protocol for High Tibial Osteotomy (HTO). https://www.massgeneral.org/assets/MGH/pdf/orthopaedics/sports-medicine/physical-therapy/rehabilitation-protocol-for-high-tibial-osteotomy.pdf
66. Al-Amri, M. N., et al. (2023). Incidence of Complications and Revision Surgery After High Tibial Osteotomy: A Systematic Review. Orthopaedic Journal of Sports Medicine, 11(2), 232596712211512.

The Application of Stride One for Selected Health Conditions



In **cartilage repair** (e.g. microfracture, Autologous Chondrocyte Implantation (ACI), and Osteochondral Autograft Transfer System (OATS)) strict weight-bearing restrictions are used: safe and progressive weight-bearing is essential for protecting healing tissue from load/shear forces[67].

Stride One's accurate feedback is crucial for adhering to strict NWB/PWB protocols and ensuring optimal, gradual loading to protect the delicate cartilage repair. By guiding precise loading and movement, Stride One can help prevent re-injury or failure of the cartilage repair.

Biofeedback helps patients perform exercises within safe ranges and with appropriate load, preventing shear forces that could damage the repair. Visual progress and objective data can motivate patients through the often very slow and restrictive early rehabilitation phases.

Stride One provides surgeons with quantitative data on patient compliance with weight-bearing restrictions, crucial for optimal cartilage healing.

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Stride One is a Class I medical device certified under the Medical Device Directive 93/42/EEC. It conforms to applicable EU safety and performance requirements and bears the CE mark. This certification applies solely to the product's current intended use and classification under MDD. Stride One is intended to support post-operative rehabilitation following lower-limb orthopedic procedures. It is not intended to replace clinical judgment, professional physiotherapy, or prescribed rehabilitation protocols. Use should be advised by a healthcare professional. Clinical decisions should be based on the full clinical context, including patient-specific factors and professional expertise. Patient selection, rehabilitation protocols, and monitoring remain the sole responsibility of the treating healthcare provider. The device is currently undergoing further clinical validation. Ceriter makes no claims regarding treatment outcomes or specific levels of efficacy beyond the scope of its certified use.

References:

67. Lahey Hospital & Medical Center. Microfracture, OATS, ACI Rehabilitation Protocol. https://www.lahey.org/-/media/files/lhmc/orthopedics/knee/lhmc-microfracture-oats-aci.pdf