Gravity off, game on: accelerating recovery and running load readiness in elite football – four case studies supported with data-driven monitoring

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Headline

Rehabilitation of lower limb injuries in elite athletes often prioritizes tissue healing in the early stages, resulting in players being cleared for running with insufficient chronic load and limited fitness. This delay in chronic load and fitness development can substantially hamper their progression once they return to the pitch, requiring additional time to adapt to higher training loads, rebuild aerobic capacity, and regain sport-specific readiness. Elite sports environments are increasingly adopting antigravity treadmills (AGT) as an effective solution to this challenge, enabling early loading with controlled body weight support (Debecker 2020). This technology facilitates safe gait training and gradual running load progression while minimizing joint stress and protecting healing tissues. Importantly, AGT training may also help maintain cardiovascular fitness and muscle activation patterns, addressing the common gap in readiness upon return to training.

While studies have demonstrated the general benefits of AGT in rehabilitation, such as reduced ground reaction forces and an earlier reintroduction to running (Vincent et al., 2022; McNeill et al., 2015), their specific impact on chronic load progression and fitness in elite football players has not been comprehensively investigated. To our knowledge, this is the first study to explore the role AGT in building chronic load and fitness during rehabilitation in a population of elite European football players, offering novel insights into its efficacy in optimizing return-to-play outcomes.

Aim

The aim of this paper is to evaluate the effectiveness of antigravity treadmills (AGT) in the rehabilitation of elite football (soccer) players, emphasizing time-efficient chronic load progression through four anonymized case studies. We combined advanced force measurement systems (ForceDecks, ForceFrame, and NordBord) with careful monitoring of pain, swelling, and wellness to assess the appropriateness and impact of AGT on key progression criteria, ensuring its safety, physiological benefits, and practicality in optimizing readiness for return to play.

Population

We utilized data from four elite football players, comprising both young and adult athletes (2 males and 2 females), rehabilitated within top-tier European leagues. The injuries addressed were 1) lateral ankle ligament reconstruction, 2) lateral meniscus repair, 3) ACL reconstruction with RAMP lesion repair, and 4) surgical treatment of femoral condyle osteochondritis. All athletes underwent surgical intervention followed by a structured rehabilitation program incorporating AGT training. Specific demographic details are omitted to maintain confidentiality. All four players were under professional contracts and provided written informed consent for their data to be included in this report.

The return-to-play (RTP) process typically progresses through distinct phases, starting with early-, mid-, and late-stage rehabilitation including the return to running outside (RO), and transitioning into the return-to-play continuum (Armitage 2022). This continuum includes on-field rehabilitation (OFR), followed by a return to team training (RTT), a return to competitive match play (RTC), and ultimately, a full return to performance (RTPerf).

It is important to note that not all players were rehabilitated and monitored across the entire rehabilitation spectrum (i.e., up to RTC or RTPerf) for reasons that cannot be disclosed for confidentiality. The lateral ankle ligament reconstruction case was monitored through the RTT phase. The lateral meniscus repair and femoral condyle osteochondritis cases were monitored through the OFR phase, with partial follow-up for the osteochondritis case until RTT. Finally, the ACL reconstruction case was monitored through the end of the running outside phase.

Methods

AGT Protocol

All AGT sessions were initiated during the subacute phase post-surgery, complementing various other training components, including injury-specific recovery exercises, strength training, running mechanics, motor control work (Kotsifaki 2023a), and cross-training (primarily cycling, when permitted) to maintain metabolic conditioning (Buchheit 2023b). AGT sessions were initiated once specific criteria were met for each case, ensuring readiness and minimizing risk. These criteria included: surgeon clearance, the ability to perform a single-leg squat without dynamic knee valgus or hip adduction, quadriceps EMG activation $> 90\%$ compared to the uninvolved side (with a focus on the vastus medialis), completion of 10 pogo jumps (if jumping was permitted), at least three weeks of strength training for quadriceps, hamstrings, triceps surae, adductors, and abductors (when indicated), and a single-leg calf raise LSI $> 0.8\%$ compared to the uninvolved side. On the

AGT, initial body weight support was set between 60–70%, tailored to each player's clinical assessment and tolerance (Tables 1 to 4). Speed and load parameters were progressively adjusted on a weekly basis (Tables 1 to 4), aiming to restore full weight-bearing capacity and replicate on-field conditions. This approach aligns with protocols suggesting a gradual reduction of body weight support to safely increase load during rehabilitation (Kim et al., 2020).

Monitoring of the response

The following metrics were assessed weekly. These monitoring tools align with those used in studies on AGT rehabilitation (Henkelmann et al., 2021; Kim et al., 2020) and in general rehabilitation case studies even the specific use of AGT (Buchheit 2023a, Taberner 2018, 2019).

- **Perceived pain and knee swelling**: Pain levels were measured using a numerical rating scale (0- no pain, 1 up to 3 - mild pain, 4 up to 6 - moderate pain, 7 up to 9 - severe pain, 10- worst pain imaginable), while knee swelling was assessed and rated with a dichotomous scale (yes/no).
- **Overall wellness**: The wellness questionnaire evaluated comprehensive clinical and psychological sensations (1- excellent, 2- very good, 3 - good, 4- normal, 5 - medium, 6 - very medium, 7 - bad, 8 - very bad, 9 - highly uncomfortable 10- very highly uncomfortable).
- **Leg function and strength**: Functional performance was assessed using a series of jump tests (CMJ, DJ, SLCMJ, SLDJ) conducted on force plates (ForceDecks, Vald). Determining the best metrics and thresholds to guide progression remains a complex and ongoing discussion, but most assessments were based on the available literature (Bishop, 2023; Buchheit 2025; Cohen 2014; Dutaillis 2023; Hart 2019; Kotsifaki 2023b; Vald 2024). These tests were complemented by strength assessments using the NordBord (i.e., Nordic Hamastring test) and the ForceFrame (i.e., isometric test for adductors) (Vald), providing a comprehensive evaluation of general strength (Taberner, 2018; Taberner, 2019). Other injury-specific tests, such as AnkleGo (Picot 2024) for the ankle, or the ASLR, Jurdan test (Lahti 2021), and groin assessments, were also performed but are not included here to keep the report concise and focused on the response to AGT. The presented tests were chosen for their consistency across all injury types.
- **Fitness**: Fitness was assessed in two of the four players using different methods: one underwent a maximal all-out 1600m run, used as a surrogate for maximal aerobic speed (MAS) (Buchheit & Laursen, 2013), while the other was evaluated via the blood lactate response to a standardized running bout (i.e., 6 minutes at 13.5 km/h), commonly referred to as the Mognoni test (Sirtori 1993)- with the lower the lactate response, the fitter the player.

Results

The progression of running load, as measured by body weight support (%BW) and treadmill speed, is illustrated in Figures 1, 3, 5, and 7; Tables 1 to 4). All four figures highlight the individualized adjustments made during the RTP program for each of the four elite football players, alongside key monitoring variables such as pain, knee swelling, and overall wellness when training. Most strength-related metrics reached or neared pre-injury levels by the end of rehabilitation, with limb asymmetries reduced to acceptable thresholds, supporting a safe RTT (Figures 2, 4, 6, and 8). On a few occasions, players progressed despite not fully meeting specific progression criteria. These decisions are detailed for each case, considering the broader context, such as isolated test deviations among otherwise strong results, the specific nature of the injury, or the influence of external factors, like tests performed after a demanding training week. Detailed outcomes and times for RTT for each player are presented below, focusing on their specific injuries and rehabilitation progress, including adjustments in AGT parameters and corresponding improvements in monitored variables.

1. Lateral ankle ligament reconstruction

The time to RTT was 12 weeks. The athlete progressed from 60% to 95% body weight support over three weeks pain-free, apart from mild pain in the 3rd week of ATG, which did not affect progress (Figure 1 and Table 1). During sessions, the player ran up to 4-6 km, structured as 5-7 intervals of 2-8 minutes each (Table 1). Overall, most metrics returned to or approached pre-injury levels by the end of the rehabilitation period, and asymmetries between limbs were reduced to acceptable thresholds (i.e., jump height LSI of 94% and 109% for SLCMJ and SLDJ), ensuring readiness for safe return-to-play (Figure 2). Performance on the 1600-meter maximal aerobic speed (MAS) test demonstrates that the player regained pre-surgery fitness levels by the time of RTT, reflecting full recovery of aerobic power (Figure 2).

Table 1. Detailed running progression on the antigravity treadmill for an elite football player rehabilitating from a lateral ankle ligament reconstruction. Speed is provided in km/h.

	Session N°	% BW	Minimal speed (km.h)	Maximal speed (km.h)	Average speed (km/h)	Total Running time (min)	Number of Block	Block duration (min)	Session distance (m)
Week 5	1	60	10	10	10	10	5	2	1662
	2	65	10	10	10	12	6	2	1994
Week 6	3	70	10	12	11,3	14	7	2	2618
	4	75	10	12	11	18	6	3	3283
	5	80	10	12	11	18	6	3	3283
Week 7	6	80	10	13	11,7	24	3	8	4723
	7	85	9	15	12,6	20	5	4	4032
	8	95	9	16	12,6	30	5	6	6111

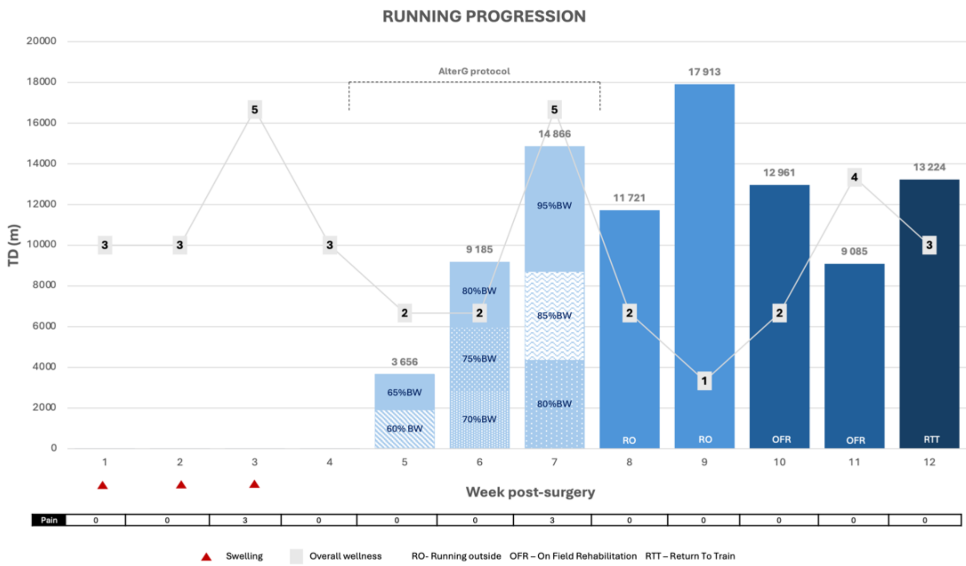


Fig. 1. **Evolution of total running load (with % body weight when running on the AGT) throughout the return-to-train (RTT) program for an elite football player rehabilitating from a lateral ankle ligament reconstruction. The graph also depicts trends in key monitoring variables, including pain (0- no pain, 10- worst pain imaginable), swelling (yes/no), and overall wellness scores (1- excellent, 10- very highly uncomfortable). Individualized progression in running load reflects a gradual increase in load tolerance while maintaining safety and monitoring recovery responses.**

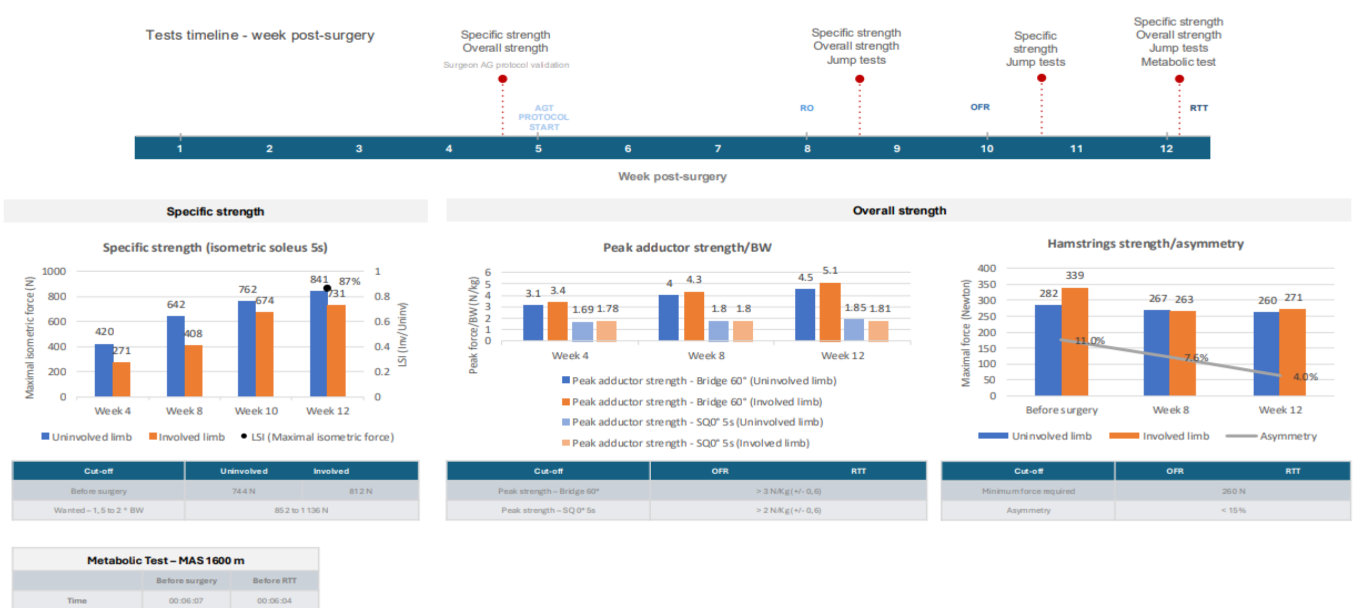


Fig. 2a. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral ankle ligament reconstruction, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

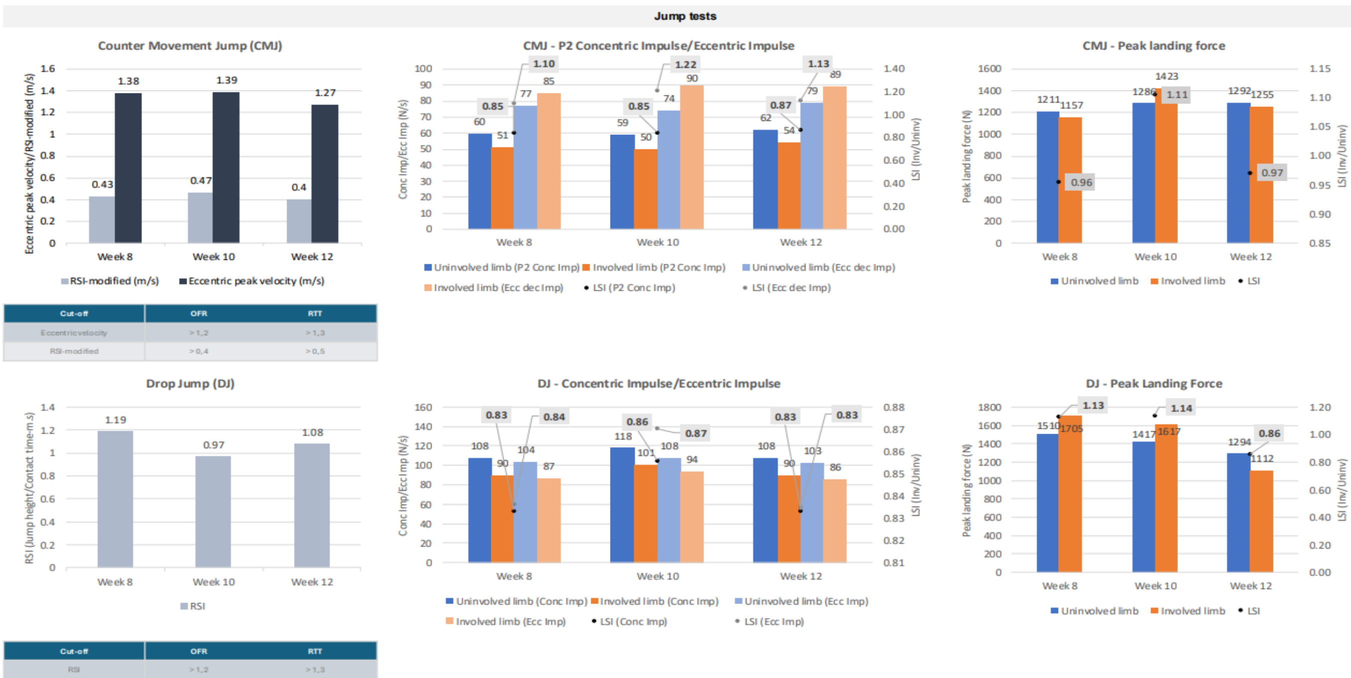


Fig. 2b. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral ankle ligament reconstruction, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

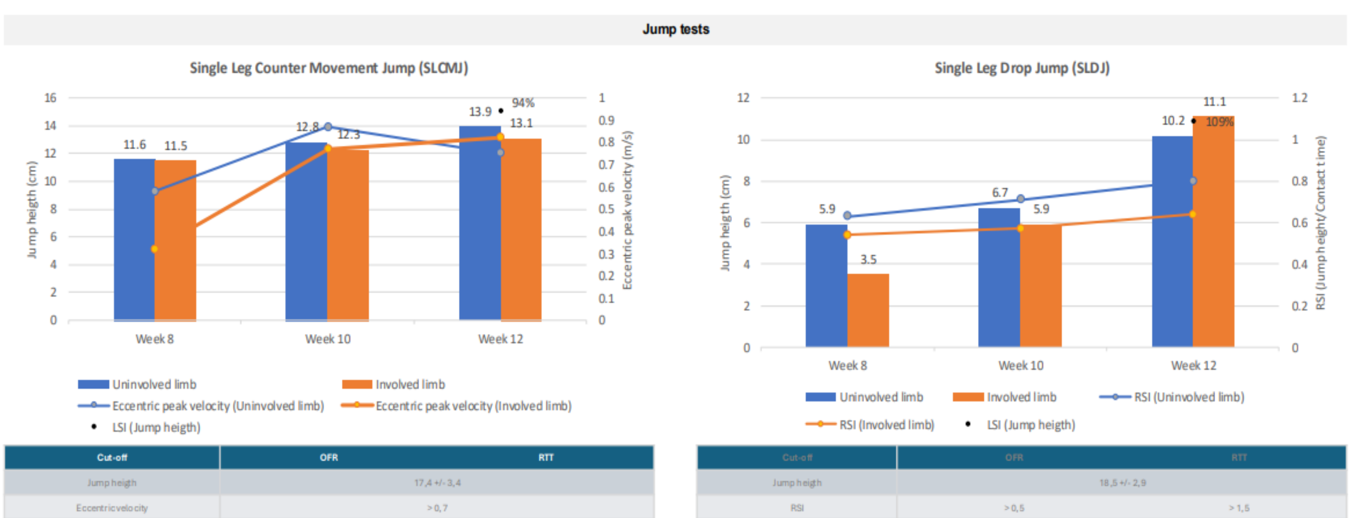


Fig. 2c. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral ankle ligament reconstruction, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

2. lateral meniscus repair

The time to RTT was 5 months and 13 days. The player progressed from 60% to 95% body weight support over four weeks (Figure 3 and Table 2). During sessions, the player ran up to 4-5 km, structured as 5-7 intervals of 2-5 minutes each (Table 2). Pain was reduced throughout the progression on AGT (score 3 to 1). Overall wellness quickly stabilized during the AGT protocol around a good score of score 3. Overall, most metrics returned to or approached pre-injury levels by the end of the rehabilitation period, and asymmetries between limbs were reduced to acceptable thresholds (i.e., LSI of 88% and 83% for SLCMJ and SLDJ), ensuring readiness for safe return-to-train (Figure 4). Finally, blood lactate levels during the Mognoni test decreased slightly from week 20 to 22 but remained above the pre-injury baseline (Figure 4).

Table 2. Detailed running progression on the antigravity treadmill for an elite football player rehabilitating from a lateral meniscus repair. Speed is provided in km/h.

	Session N°	% BW	Minimal speed (km.h)	Maximal speed (km.h)	Average speed (km/h)	Total Running time (min)	Number of Block	Block duration (min)	Session distance (m)
Week 13	1	60	10	10	10	10	5	2	1662
	2	60	10	10	10	12	6	2	1994
Week 14	3	65	10	10	10	14	7	2	2326
	4	70	10	10	10	14	7	2	2326
	5	70	10	10	10	18	6	3	2991
Week 15	6	75	10	10	10	18	6	3	2991
	7	80	10	10	10	18	6	3	2991
	8	80	10	10	10	24	6	4	3988
Week 16	9	85	10	10	10	25	5	5	4155
	10	90	10	10	10	25	5	5	4155
	11	95	10	10	10	25	5	5	4155

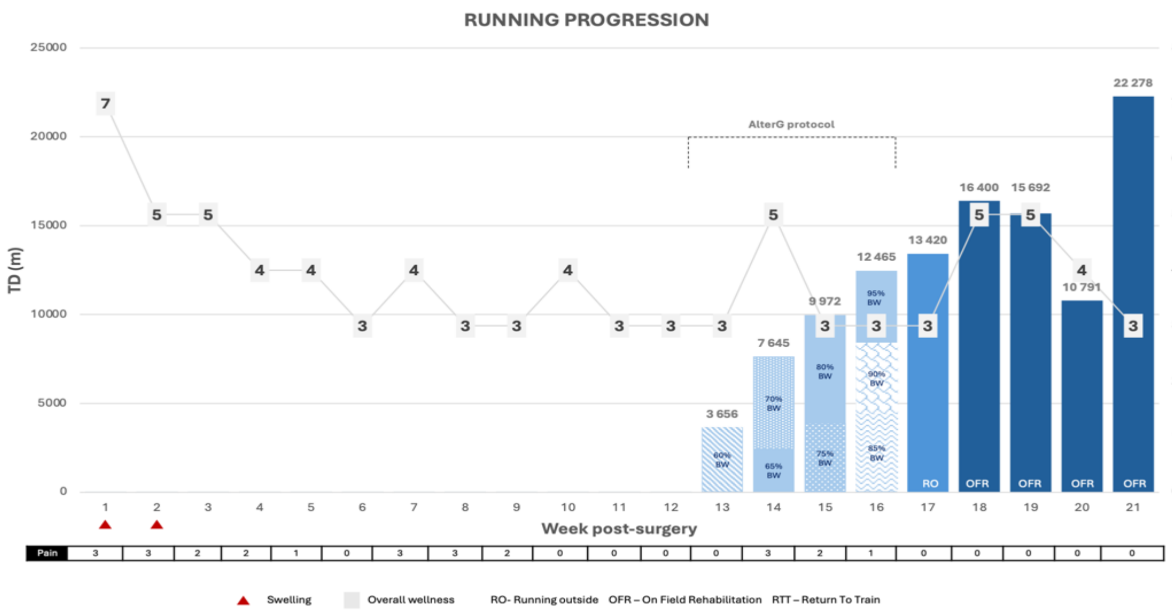


Fig. 3. Evolution of total running load (with % body weight when running on the AGT) throughout the return-to-train (RTT) program for an elite football player rehabilitating from a lateral meniscus repair. The graph also depicts trends in key monitoring variables, including including pain (0- no pain, 10- worst pain imaginable), swelling (yes/no), and overall wellness scores (1- excellent, 10- very highly uncomfortable). Individualized progression in running load reflects a gradual increase in load tolerance while maintaining safety and monitoring recovery responses.

Fig. 4a. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral meniscus repair, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

Fig. 4b. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral meniscus repair, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

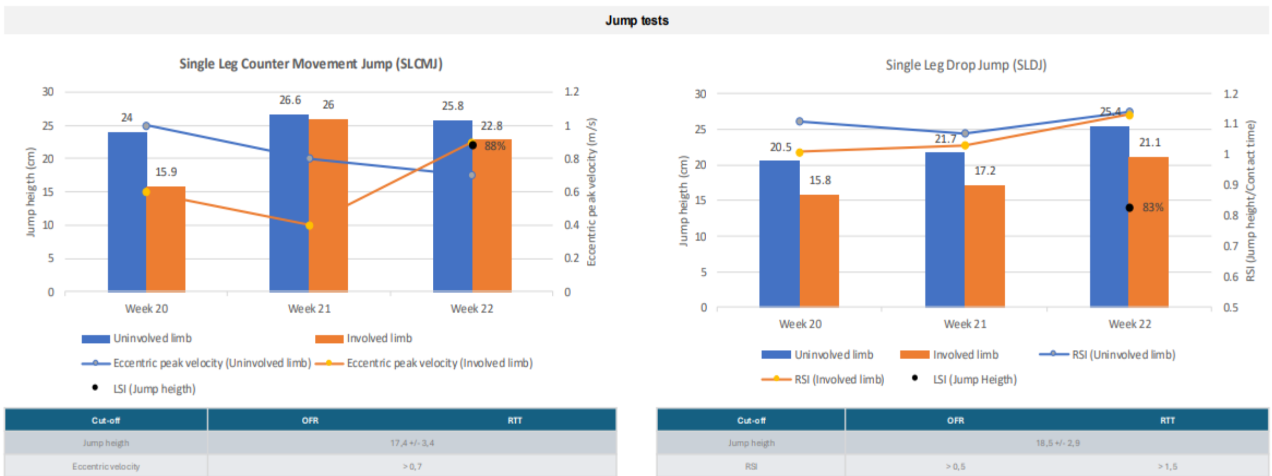


Fig. 4c. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from a lateral meniscus repair, highlighting specific strength, overall strength, jump tests, and metabolic test outcomes.

3. ACL reconstruction with RAMP lesion repair

The time to RTT was 6 months and 26 days (206 days). The athlete progressed from 70% to 90% body weight support over two weeks (Figure 5 and Table 3). During sessions, the player ran up to 4-5 km, structured as 6-8 intervals of 2-4 minutes each (Table 3). No pain was reported throughout the AGT protocol. Notably, the knee was dry after just one month, which is substantially faster than what is generally reported in similar cases. Overall wellness remained good and began to stabilize with the start of outdoor running sessions. By the end of the monitored period (Week 18, after the first two weeks of the "running outside" phase, Figure 5), most recovery metrics showed improvements, achieving encouraging results such as CMJ eccentric peak velocity >1.2 m/s, while some limb asymmetries were reduced to acceptable thresholds for the phase (e.g., Concentric and Eccentric Impulses LSI during CMJ and DJ >0.75, LSI >0.90 for SLCMJ jump height) (Figure 6).

However, the player still showed some large asymmetries (peak landing force LSI of 0.44 for DJ, jump height LSI of 0.58 for SLDJ, Figure 6), and a slight decline in overall SLDJ jump height performance, with lower values at Week 18 compared to Week 17. This transient decline in jump height was likely due to the high training load and accumulated fatigue following the preceding week (total distance of 13 km and decreases in both DJ RSI and CMJ RSImod). The team then collectively decided to extend the "running outside" phase for three additional weeks to address these deficits before progressing to the OFR phase at Week 21 (not monitored or shown here).

Table 3. Detailed running progression on the antigravity treadmill for an elite football player rehabilitating from ACL reconstruction with RAMP lesion repair. Speed is provided in km/h.

	Session N°	% BW	Minimal speed (km.h)	Maximal speed (km.h)	Average speed (km/h)	Total Running time (min)	Number of Block	Block duration (min)	Session distance (m)
Week 15	1	70	10	10	10	12	6	2	1994
	2	75	10	10	10	14	7	2	2326
	3	75	10	10	10	18	6	3	2991
Week 16	4	80	10	13	11,5	21	7	3	4019
	5	85	10	13	11,5	24	8	3	4593
	6	90	10	13	11,5	24	6	4	4593

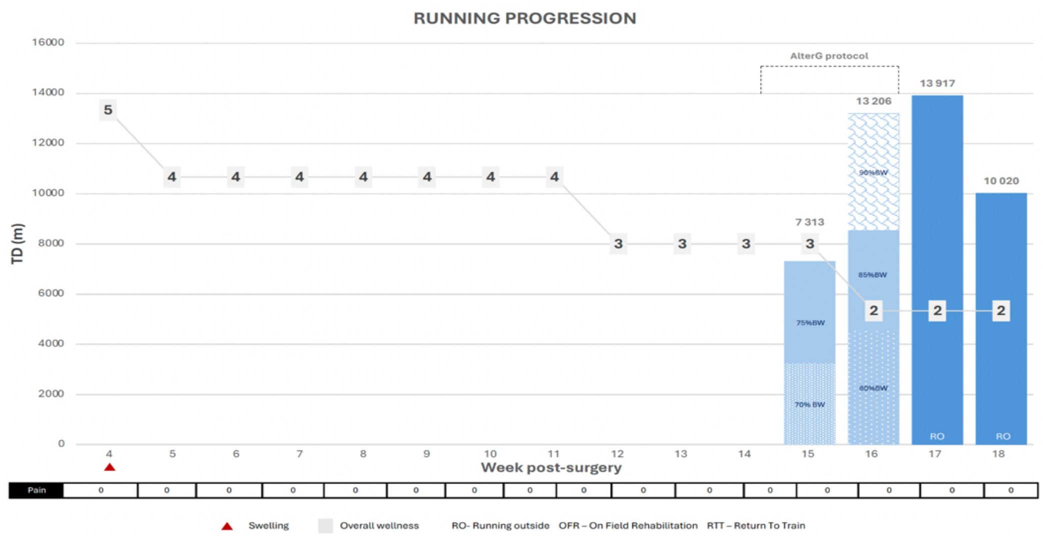


Fig. 5. Evolution of total running load (with % body weight when running on the AGT) throughout the return-to-train (RTT) program for an elite football player rehabilitating from an ACL reconstruction with RAMP lesion repair. The graph also depicts trends in key monitoring variables, including pain (0- no pain, 10- worst pain imaginable), swelling (yes/no), and overall wellness scores (1- excellent, 10- very highly uncomfortable). Individualized progression in running load reflects a gradual increase in load tolerance while maintaining safety and monitoring recovery responses.

Fig. 6a. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from ACL reconstruction with RAMP lesion repair, highlighting specific strength, overall strength, jump tests outcomes.

Fig. 6b. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from ACL reconstruction with RAMP lesion repair, highlighting specific strength, overall strength, jump tests outcomes.

Fig. 6c. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from ACL reconstruction with RAMP lesion repair, highlighting specific strength, overall strength, jump tests outcomes.

4. Surgical treatment of femoral condyle osteochondritis

The time to RTT was 5 months and 18 days. The athlete progressed from 60% to 95% body weight support over four weeks (two weeks of holiday without access to AGT). During sessions, the player ran up to 4-5 km, structured as 5-7 intervals of 2-5 minutes each (Table 4). No pain was reported throughout the AGT protocol and stabilization of overall wellness with good sensations (score 3) (Figure 7). Overall, most metrics returned to or approached pre-injury levels by the end of the rehabilitation period, and asymmetries between limbs were reduced to acceptable thresholds, ensuring readiness for safe return-to-train (Figure 8). Of note, a drop in absolute SLCMJ jump height was observed for both legs, with the LSI remaining stable at 0.95. While this may have been influenced by the heavy training load in the preceding weeks, the exact reason for the decline is unclear, especially given the unchanged RSI and RSImod and stable SLDJ performance. As a consequence, the team concluded that this decline in SLCMJ was temporary and opted to progress the player without delay, still allowing for further work on deficits in the next phase of rehabilitation.

Table 4. Detailed running progression on the antigravity treadmill for an elite football player rehabilitating from surgical treatment of femoral condyle osteochondritis. Speed is provided in km/h.

	Session N°	% BW	Minimal speed (km.h)	Maximal speed (km.h)	Average speed (km/h)	Total Running time (min)	Number of Block	Block duration (min)	Session distance (m)
Week 14	1	60	10	10	10	12	6	2	1994
	2	65	10	10	10	12	6	2	1994
Week 15	3	70	10	10	10	14	7	2	2326
	4	70	10	10	10	18	6	3	2991
	5	75	10	12	11	18	6	3	3294
Week 18	6	80	10	12	11	18	6	3	3294
	7	85	10	12	11	20	5	4	3660
Week 19	8	85	11	13	12	25	5	5	4950
	9	90	11	13	12	20	5	4	3960
	10	95	11	13	12	25	5	5	4950

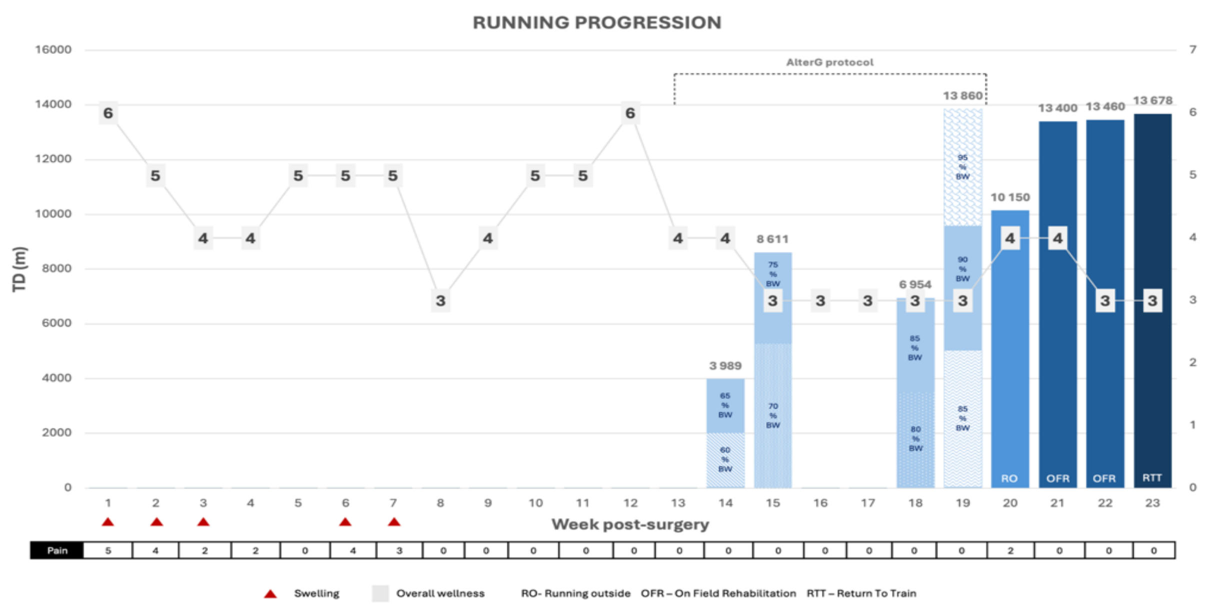


Fig. 7. Evolution of total running load (with % body weight when running on the AGT) throughout the return-to-train (RTT) program for an elite football player rehabilitating from surgical treatment of femoral condyle osteochondritis. The graph also depicts trends in key monitoring variables, including pain (0- no pain, 10- worst pain imaginable), swelling (yes/no) and overall wellness scores (1- excellent, 10- very highly uncomfortable). Individualized progression in running load reflects a gradual increase in load tolerance while maintaining safety and monitoring recovery responses.

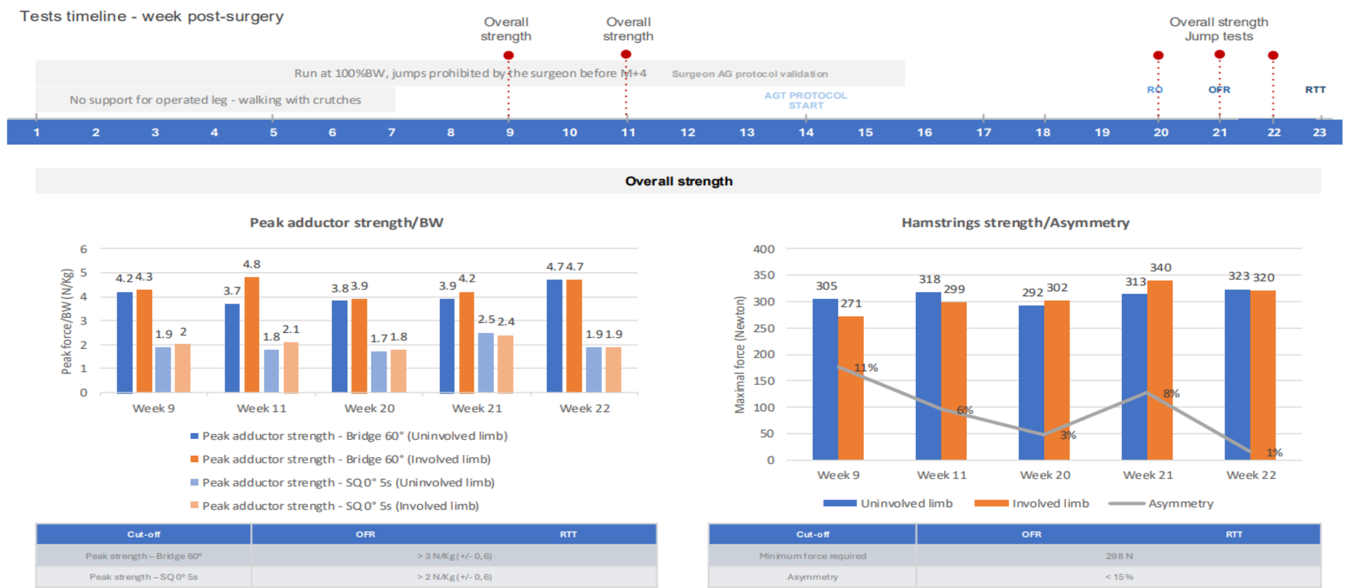


Fig. 8a. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from surgical treatment of femoral condyle osteochondritis, highlighting specific strength, overall strength, and jump tests outcomes.

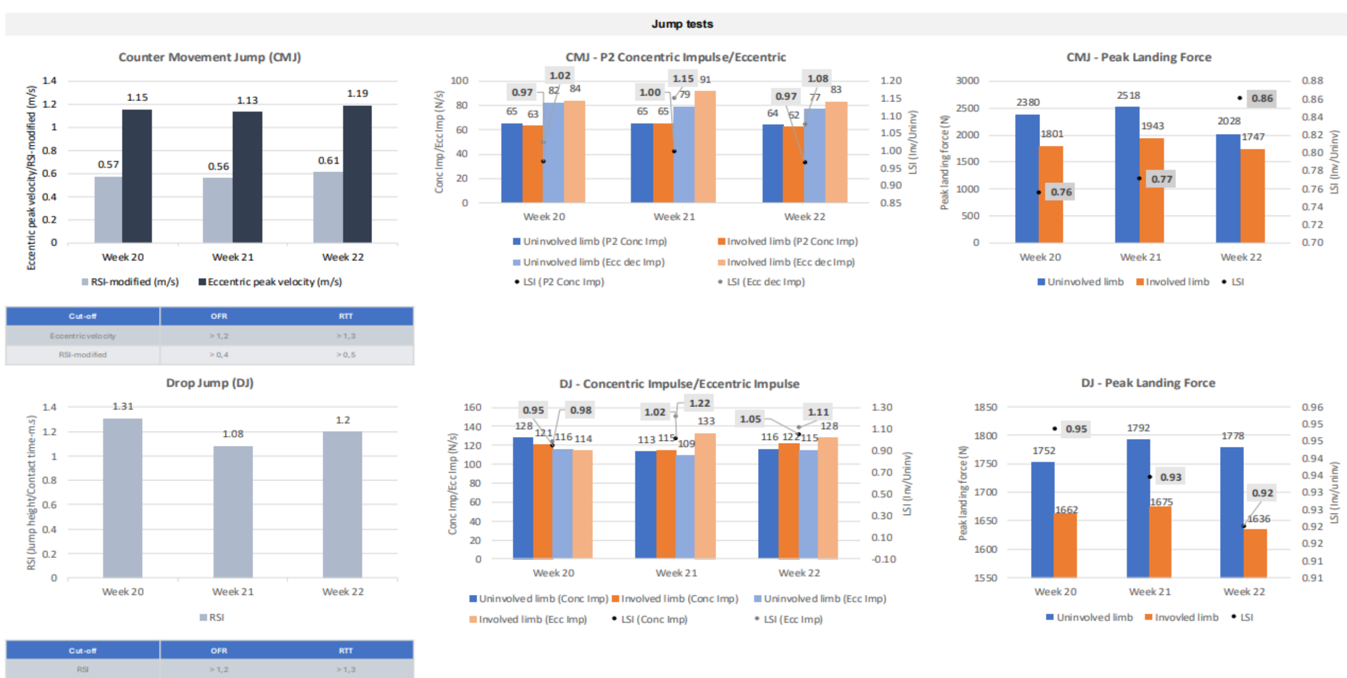
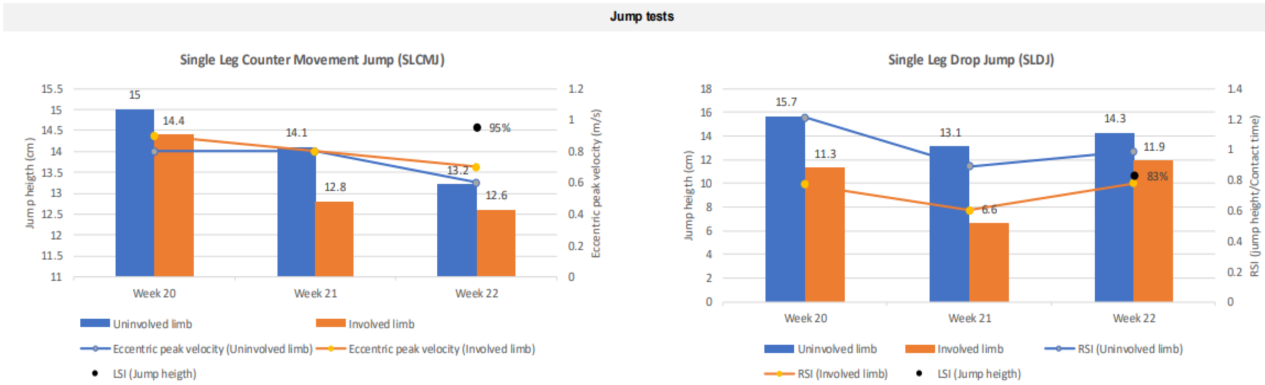


Fig. 8b. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from surgical treatment of femoral condyle osteochondritis, highlighting specific strength, overall strength, and jump tests outcomes.



Cut-off	OFR	RTT
Jump heigth	17,4 +/- 3,4	
Eccentric velocity	> 0,7	

Cut-off	OFR	RTT
Jump heigth	18,5 +/- 2,9	
RSI	> 0,5	> 1,5

Fig. 8c. Overview of rehabilitation progress across weeks post-surgery for an elite football player rehabilitating from surgical treatment of femoral condyle osteochondritis, highlighting specific strength, overall strength, and jump tests outcomes.

Discussion and Conclusion

During AGT sessions, players progressed from 60% to 95% body weight support over four weeks, running at speeds of 10 to 16 km/h. Distances ranged from 4 to 6 km per session, structured as 5 to 8 intervals of 2 to 5 minutes each, with total session durations of 10 to 30 minutes (Tables 1, 2, 3, and 4). This study demonstrates for the first time in elite soccer players how using AGT can facilitate a gradual and controlled progression of chronic load, addressing a critical gap in preparedness that can delay return-to-train readiness. The use of AGT in rehabilitation allows for early mobilization with reduced joint loading, which is crucial in protecting healing tissues while restoring function (Kim 2020). This approach has been shown to decrease ground reaction forces and joint stress, facilitating a safer transition to full weight-bearing activities (Vincent et al., 2022). Additionally, AGT training aids in maintaining aerobic capacity and muscle activation patterns, which are essential for athletic performance (McNeill et al., 2015).

Based on published benchmarks, all four players returned to training and competition within the expected timeframes. In the literature, RTP is often defined as the time when the medical team allows the player to return to full participation (Ekstrand, 2020), a designation that likely aligns with the RTT phase described in the present article. For the player recovering from ankle surgery, RTP is typically achieved in 12.45 weeks (Li, 2023), and this player reached RTT at 12 weeks. For lateral meniscus repair, RTP usually takes 4–6 months (Hanna, 2022), and this player reached RTT in 5 months and 13 days, well within the expected range. Following ACL reconstruction with RAMP lesion repair, RTP generally occurs at 7 months (210 days) (Ekstrand, 2020). This player returned within a very similar time frame (i.e., 6 months and 26 days), despite the added complexity of RAMP lesion repair, which often prolongs recovery. Lastly, for the osteochondritis case, RTP is typically achieved in 7.2 months (Coladonato, 2024), whereas this player reached RTT in 5 months and 18 days, ahead of standard timelines.

Notably, these timeframes were achieved without adverse responses in terms of pain, swelling, or overall wellness, even under high running loads (12.5 to 15 per week, Figures 1, 3, 5, and 7). Importantly, we utilized Vald's measurement systems (ForceDecks, ForceFrame, and NordBord) to monitor the functional strength of both the involved and uninvolved limbs, guiding rehabilitation progression throughout the process (Buchheit 2023a & 2025, Taberner, 2018; Taberner, 2019). By the end of rehabilitation, most lower limb strength metrics had either recovered to or nearly reached pre-injury levels, with limb asymmetries reduced to acceptable thresholds (LSI >85%), ensuring readiness for a safe return to training (Figures 2, 4, 6, and 8). When certain metrics were not fully normalized by the end of rehabilitation (e.g., SLDJ performance, Figure 6, SLCMJ performance, Figure 8), it was assumed that: 1) the drop in neuromuscular performance might be transient, particularly if the test followed a heavy workload in the preceding week, 2) players could still safely progress to the next phase (e.g., OFR or RTT before RTComp) under controlled conditions, and 3) any remaining deficits would be addressed in subsequent rehabilitation phases. The elevated blood lactate levels observed during the Mognoni test for the player recovering from a lateral meniscus repair, which remained above pre-injury baseline levels (Figure 4), indicated that while the player was cleared to return to team training, additional work on aerobic fitness was needed to fully restore pre-injury conditioning. This overall criteria-based yet flexible approach prevents unnecessary delays in rehabilitation while ensuring players achieve optimal performance and readiness for training or competition. Such decisions are always made collectively, balancing the goal of fast-tracking recovery with careful risk management (Buchheit 2023a).

By enabling players to build chronic generic running load levels approaching those experienced during team training several weeks in advance, AGT likely reduces the risk of a sudden spike in running load upon returning to the pitch (Drew, 2016). Although treadmill running differs significantly from on-pitch football training in terms of locomotor patterns and muscle activity, it still serves as an effective alternative to maintain load progression when field training is not yet feasible. This controlled progression is believed to be optimal not only for protecting the injured tissue but also for reducing the overall risk of injury to other structures. These findings strongly support the integration of AGT into rehabilitation programs as an effective strategy for time-efficient and comprehensive recovery in elite athletes (Moore 2010, Humanly 2017, Kim 2020). We believe that the use of AGT played a significant role in maintaining fitness or at least limiting deconditioning during rehabilitation. This was highly effective in one player (lateral ankle ligament reconstruction, Figure 2), moderately successful in another (lateral meniscus repair, Figure 4), and unfortunately not measured in the remaining two players. Overall, the outcomes were positive, as greater deconditioning could have occurred without AGT. This aligns with findings in the literature (Buchheit 2023a, McNeill 2015), which highlight the benefits of AGT in preserving cardiovascular fitness during injury recovery.

Importantly, while the use of antigravity treadmills (AGT) offers significant advantages in rebuilding chronic generic running load and limiting deconditioning during rehabilitation, it is essential to recognize potential limitations. The time dedicated to treadmill-based training inevitably comes at the expense of other important rehabilitation objectives, such as strength (re)development, motor control, and running mechanics, which are equally critical for a successful return to sport. These competing demands highlight the need for a balanced approach to ensure that AGT sessions do not overshadow other essential training elements.

In professional settings, where athletes have access to comprehensive support and adequate time, these training contents can be approached as complementary rather than competing. By integrating AGT work with strength, control, and mechanics training, the overall rehabilitation program becomes more holistic and ultimately serves the best interests of the player. A mindful approach that harmonizes these elements is key to achieving an optimal and sustainable return to performance. This report has several limitations that should be acknowledged. Knee strength, a key metric for assessing recovery in knee-related injuries, was not reported. In some cases, testing was not feasible, and in others, data could not be included due to factors beyond our control. Ideally, more objective measures would have been used alongside swelling and wellness to better evaluate tolerance to AGT. However, jumps were not performed earlier in the rehabilitation process to minimize impacts and ensure recovery was not compromised (especially for lateral meniscus repair and femoral condyle osteochondritis.)

Non-injury-specific strength assessments, such as knee flexor and adductor testing, were performed but were primarily used as indicators of overall health and recovery rather than specific tolerance to AGT. These limitations underscore the need for a more comprehensive and consistent assessment approach in future applications.

Key Take-Home Messages

- **Efficient chronic load development**: Antigravity treadmills (AGT) allow elite football players to progressively rebuild general chronic load levels, bringing them closer to those experienced in team training, weeks before their return to the pitch.
- **Time-efficient sessions**: Players progressed from 60% to 95% body weight support, running 4-6 km at 10-16 km/h in 5-8 intervals of 2-5 minutes, totaling 10-30 minutes per session.
- **Avoiding deconditioning with AGT**: AGT proved effective in maintaining fitness or limiting deconditioning during rehabilitation, with clear benefits observed in one player, moderate success in another, and no measurements in the remaining two; overall, outcomes were positive and consistent with literature highlighting AGT's role in preserving cardiovascular fitness.
- **High training loads tolerated safely**: Players maintained high generic running loads (up to 14 km per week, Figures 1 to 4) during rehabilitation without adverse effects on pain, swelling, or overall wellness.
- **Running load compatibility**: The high running loads achieved during rehabilitation did not impede the fulfillment of discharge criteria, including strength benchmarks and acceptable asymmetry thresholds, as effectively assessed using Vald's measurement systems.
- **Expected RTP**: Across four case studies, players met return-to-sport criteria in the expected timeframes, demonstrating the efficiency of AGT in optimizing recovery.
- **Minimized risk of load spikes**: By establishing generic running load readiness early, AGT reduces the risk of sudden training load spikes, which are known to increase injury risk for both the rehabilitated tissue and other structures.
- **Balanced approach required**: While AGT is valuable, it must be integrated with strength, motor control, mechanics training and metabolic X-training to ensure a holistic rehabilitation program that addresses all clinical and critical objectives.

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