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Enhancing Body Balance and Performance in Elite Archery Athletes: The Impact of Atlasprofilax Intervention on Suboccipital Myofascia

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Case series
Patients: 3 women • 3 men
Final Diagnosis: Athlete 5, who received the Atlasprofilax procedure, showed the most favorable results in the balance assessments compared with the 5 other athletes who did not receive the intervention
Symptoms: Balance problems
Clinical Procedure: AtlasProfilax
Specialty: Orthopedics and Traumatology • Rehabilitation

Objective: Unusual clinical course
Background: High-performance athletes, such as archers, require optimal proprioception and balance. Subclinical or underestimated metabolic and pathomechanic alterations in the suboccipital myofascia could lead to loss of performance in balance and proprioception. Therapeutic optimization of myofascia and its complex structures through noninvasive stimulation by mechanotransductive vibropressure could be a preliminary key factor in high-performance athletes for high-performance sport.
Case Reports: This study was conducted with 6 athletes from the Brazilian Olympic archery team to evaluate the impact of the Atlasprofilax intervention on body balance. The results were measured using a standardized medical stabilometric platform, which assessed static balance and proprioception capacity. One athlete underwent the intervention before the entire team was tested for balance and reflexes in their archery performance. The study found that the intervened athlete showed improved balance and reflexes, as indicated by superior scores in the risk of fall assessment and fall index. The results suggest the potential for the Atlasprofilax intervention to improve body balance and proprioception in high-performance athletes.
Conclusions: A single intervention using the Atlasprofilax method in 1 of 6 Olympic archers resulted in significant improvement in balance and proprioception when compared with that of the non-intervened athletes. This preliminary evidence suggests that the Atlasprofilax intervention on the suboccipital myofascia may have a positive impact on enhancing balance and performance in elite athletes by improving proprioception.
Keywords: Atlanto-Occipital Joint • Fascia • Postural Balance
Abbreviations: AMTI – Advance Mechanical Technology Inc.

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Background

Balance in humans is complex and is dependent on biomechanics, especially in upright posture during physical activity. The suboccipital hinge, including the suboccipital myofascia, plays a crucial role in balance control owing to its high concentration of mechanoreceptors and proprioceptors, which allow for precise detection of changes in head angular posture. Imbalances in cervical alignment, particularly suboccipital (C0-C2) hyperextension, can lead to neck pain and other postural consequences [1]. Asymptomatic subclinical cervical sagittal imbalance related to C0-C2 underestimated abnormalities could potentially reduce the body's proprioception and balance, thereby impacting sports performance. Head movements are essential in affecting cerebrospinal fluid pressure, and the myodural bridge and the suboccipital muscles play a key role in this process [2]. Suboccipital muscles are involved in sensorimotor control and stabilization of the spinal cord. Several soft tissue structures that cross over the cervical epidural space connect suboccipital myofascia and dura [3]. Proprioceptive inputs from suboccipital muscles are relevant in head-eye coordination and postural performance, and those muscles have a high spindle content [4].The high density, type of distribution, and morphology of muscle spindles found in the rectus capitis posterior minor indicate their important role of "proprioceptive monitors" of the cervical spine and head, in addition their motor function [5]. Suboccipital muscle atrophy is negatively correlated with proper standing balance, reducing proprioceptive output from atrophied muscles. Loss of control in standing balance can be due to the lack of proprioceptive inhibition of nociceptors at the dorsal horn of the spinal cord [6]. Multiple studies have shown that myodural connections bridge the epidural spaces between 3 of the 4 suboccipital muscles and the dura mater [7-10]. Other studies established correlations between the suboccipital myofascia and cervical dura mater, with implications in postural control, sensorimotor function, and cervicocephalic pain syndromes [3,11,12] and other disorders, such as Arnold-Chiari malformation [13], a problem that is highly correlated with body imbalance. Alterations in cervical proprioception, sympathetic tone, balance, and dural enfolding due to cervical spine trauma have also been studied [14-16]. Fascia and its interconnections play a very important role in body alignment and myofascial tissue integrity. Changes induced in certain areas or parts of the myofascial tissues can affect others remotely [17-20].

The Atlasprofilax method is a device-mediated intervention on the suboccipital myofascia that uses mechanotransductive vibropercussion, aiming an amelioration of clinical or subclinical metabolic and structural alterations, which are often underestimated, of the soft tissues and bony structures of the occipito-cervical hinge [21]. Clinical experience with the Atlasprofilax method supports that this intervention helps in recovering or ameliorating the orthogonal cephalopodalic axis, which brings improvements in spinal curves, center of gravity, and body balance. The Atlasprofilax method has already showed benefits in jaw and temporomandibular joint disorders [22], fibromyalgia [23], and radiologic improvements in the orthogonality of the C0-C1-C2 segment [24,25]. The pathologies in which the Atlasprofilax intervention showed therapeutic gains have a correlation with postural control deficits and imbalance [26-28]. Body balance is an important health-related component of physical activity, as it can influence training and competition results in sports. Any potential physiologically induced enhancement in postural control and balance can translate into improved performance and sporting outcomes. The main characteristic of archery is that the archer adopts the most static posture possible. Its principle is stability and repetition of movements in order to obtain a consistent shot. This is key when the body is stationary (state of static equilibrium). Archery efficiency is measured by scoring arrows on a target. Research aimed at enhancing athletes' performance also examines factors such as balance, which is the capacity to maintain coordination and control in counteracting forces that can disrupt optimal performance. Athletes increase their stability when they increase the size of their base of support.

The stability of the body is closely tied to the center of gravity's projection on the base of support. A lower center of gravity leads to a more stable body. Archers require exceptional balance and postural control under static conditions. To maintain balance, the body's line of gravity within the base of support must be kept steady, with minimal postural oscillation. Multiple systems and inputs coordinate to maintain balance, including the visual, vestibular, and somatosensory systems. The proprioceptive system is essential in providing information about body positioning and movement. For archers, the base of support is a square polygonal surface that encompasses the tips of the feet and heels. Archers begin by holding the bow low in front of them and then raising it with an extended arm. This movement raises the center of gravity and shifts it to the foot closest to the target, leading to a more unstable balance. The neck joint receptors provide critical proprioceptive information to the nervous system, enabling the archer to maintain proper orientation of the head in relation to the body (**Figure 1**).

Case Reports

A member of the Brazilian archery team, comprised of 6 athletes, underwent the Atlasprofilax procedure. This was followed by a joint training session with athletes from various countries, which was held in Wonju, South Korea. The athlete who received the intervention was assigned the number 5, but their identity was kept blinded from their teammates and the

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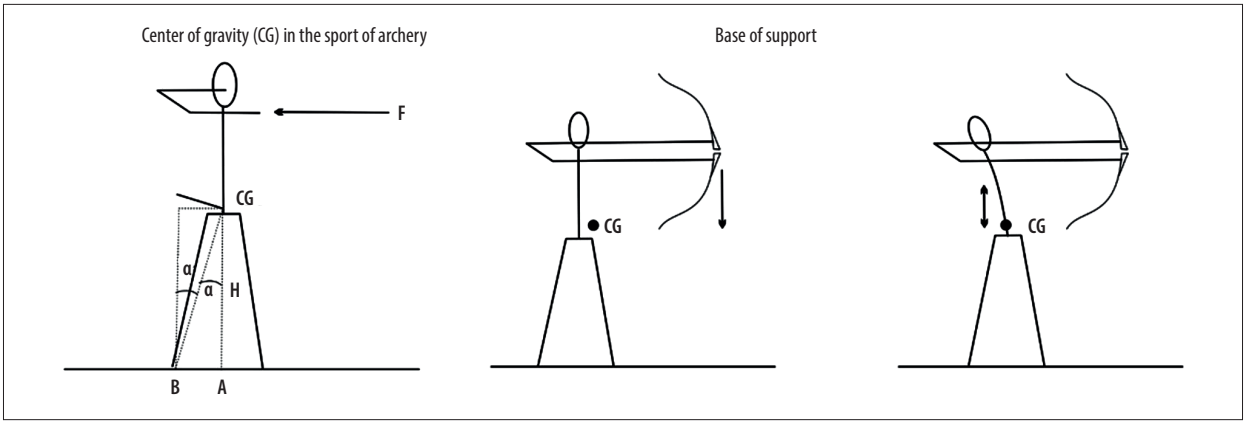

Figure 1. Center of gravity (CG) and base of support model in the sport of archery. (*Source: Fita Coachs Manual. International Archery Federation*).

Table 1. Characteristics of the 6 Brazilian athletes.

	Athlete 1	Athlete 2	Athlete 3	Athlete 4	Athlete 5	Athlete 6
Age	25.9	19.9	25	16.8	32.2	31.2
Weight	80.7	54.0	52.0	89.8	84.2	93.5
Sex	F	F	F	M	M	M
Athlete ID	1	2	3	4	5	6

Korean evaluators conducting the balance tests. The characteristics of the 6 Brazilian participants, 3 men and 3 women, are described in **Table 1**,

Clinical Intervention and Balance Testing

The intervention was performed only on athlete 5, on November 13, 2014, at the Primeira Vértebra Clinic in Belo Horizonte, Brazil. The balance tests were performed on November 25, of 2014, at Pakaesejong Clinic Sports Rehabilitation Center in South Korea. The intervention was blinded to the balance test examiners and to the other 5 athletes participating in the pilot test. The Atlasprofilax method uses intermittent percussive mechanical vibropressure mediated by a noninvasive device (**Figure 2**). The intervention was applied once during 8 min on multiple specific points of the suboccipital region to stimulate certain receptors involved in proprioception and muscle reflex. By intervening in the suboccipital region, a domino effect was pursued, aiming at an improvement in the antero-posterior and lateral symmetry of muscle chains as well as in the body's fascial tensegrity. The intervention targets a profound mechanotransduction effect on the suboccipital muscles and their multiple receptors, especially in their proprioceptors, as well as on other upper neck muscles and the cervical deep fascia. Suboccipital muscles are located within a dense fibro-fatty tissue region, which is beneath the semispinalis capitis. Multiple neck muscles act as skeletal muscles transferring downward

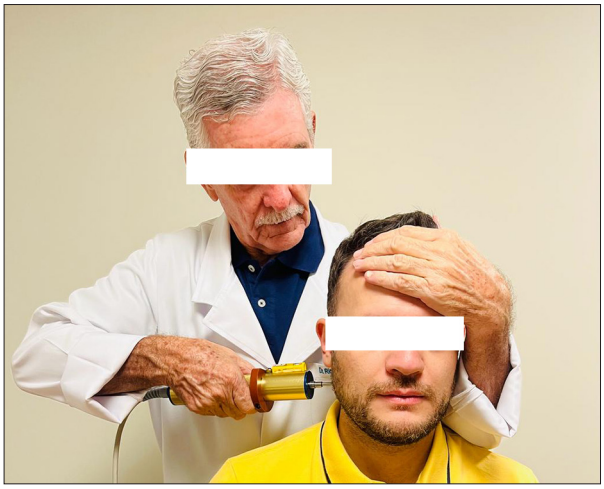

Figure 2. Health care professional trained in the Atlasprofilax method applying the intervention on a Brazilian patient.

biomechanical and elastic energy to all myofascial chains. To maintain horizontal gaze and proper balance, the craniocervical structures can counteract the loss of lordosis by modifying the physiological Cobb angle, affecting proprioception and body balance. It is very likely that subclinical alterations in suboccipital myofascia can negatively affect the myofascial chains in their symmetry, as well as the posture of the body, by altering proprioception and postural balance.

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Figure 3. Athlete performing the balance test on an Advance Mechanical Technology Inc board, with 6-plate sensors on dynamic and computerized platforms.

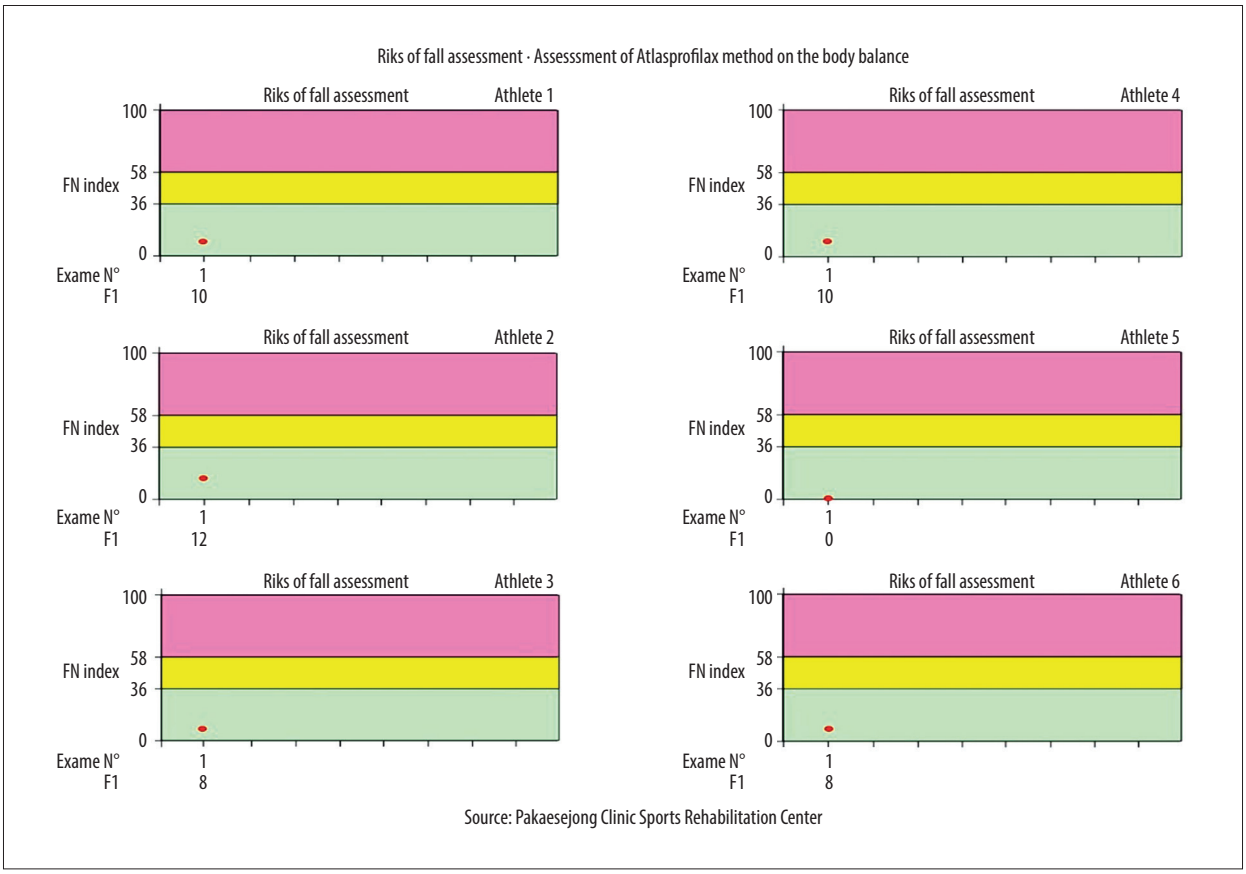

Figure 4. Primary endpoint: risk of fall according to the balance test. The closer to the XY axis (abscissa and ordinate), the greater the body balance. Athlete 5 obtained the best score, as shown in the figure.

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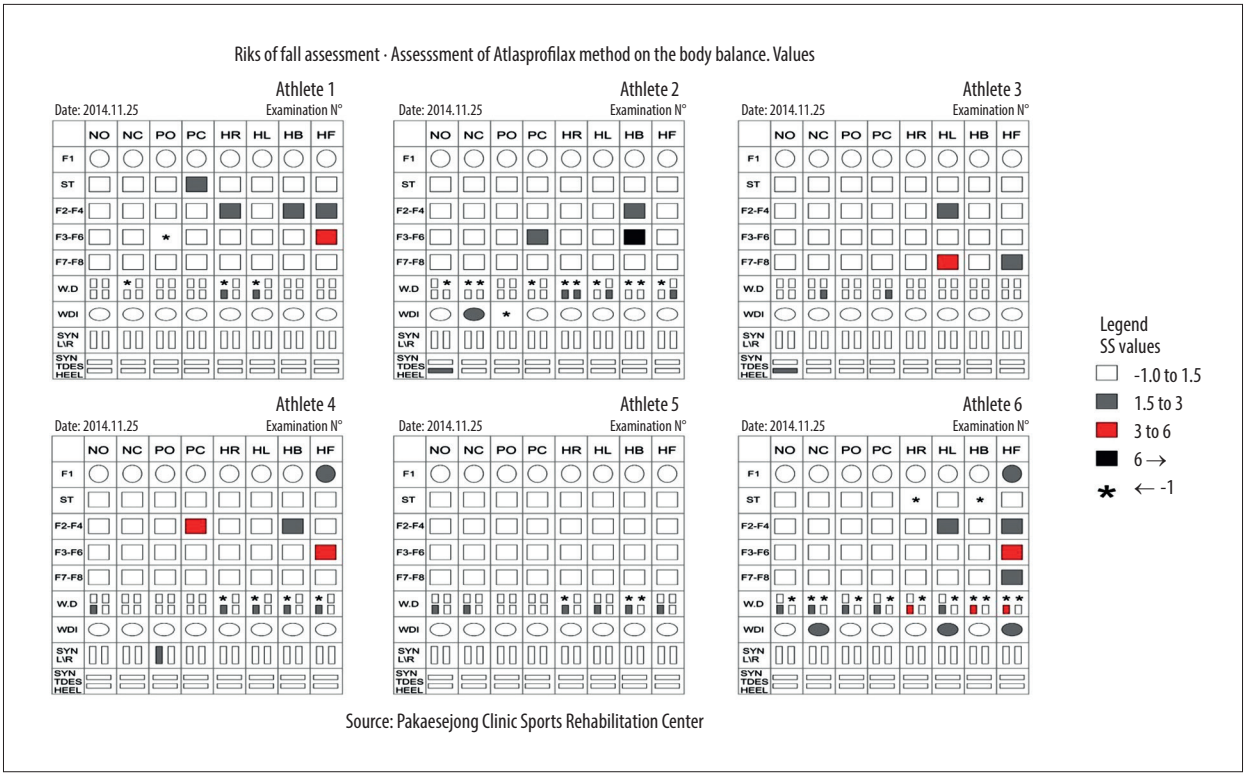

Figure 5. Secondary endpoint (fall index). This figure shows the scores obtained in the fall index. The final aggregated results are shown in **Table 2**. NO – head straight with eyes open; NC – head straight with eyes closed; PO – standing on elastic pads with eyes open; PC – standing on elastic pads with eyes closed; HR – head right with eyes closed; HL – head up with eyes closed; HB – head up with eyes closed; HF – head down with eyes closed; F1 – low frequency; 0.01-0.1 Hz, linked to visual control, typically dominating normal steady and undisturbed posture; ST, stability index); F2-F4 – medium-low frequency: 0.1-0.5 Hz, sensitive to vestibular stress and disturbances; F5-F6 – medium-high frequency: 0.5-1.0 Hz, reflect somatosensory activity in the lower extremities and spine); F7-F8 – high frequency: 1.0 Hz and above, often induced by dysfunctions in the central nervous system; W.D/WDI – weight distribution index as measured for weight distribution over the platforms; SYN L/R – load left/right distribution; SYN TDES HEEL anterior/posterior load distribution.

The 6 athletes underwent physical and balance tests at the Sports Rehabilitation Training Center in Wonju, Korea, lasting 2 h, under the same training conditions, with the same equipment, and on the same day. For balance testing, an Advance Mechanical Technology Inc (AMTI) board was used, which has features specifically produced for balance testing, with 6-board sensors, comprising dynamic and computerized platforms (**Figure 3**). This platform has a standard of excellence known worldwide for its durability and reliability of the measured data. It meets ISO 13485 standards, with medical qualification, and it has been widely used for measuring balance and proprioception in other conditions [29,30].

Table 2. Fall index results. Final score obtained for the 6 athletes (see also Figure 4). The lower the score, the lower the fall index and the better the balance and proprioception ability.

Athlete ID	Intervened	Fall index score
1	No	10
2	No	12
3	No	8
4	No	10
5	Yes	0
6	No	8

Methods, Measurements, and Endpoints

Primary and secondary endpoints were measured according to the output scores using an AMTI balance testing board that includes 6-board sensors and dynamic and computerized platforms (**Figure 3**). The primary endpoint was the risk of fall assessment (**Figure 4**). The secondary endpoint was the score of the fall index (**Figure 5, Table 2**). For measuring the primary endpoint, risk of fall assessment, the AMTI software gives a score based on an abscissa and ordinate axis. The closer the score is to the origin point of the axis, the higher the proprioceptive and balance ability and the lower the risk of fall

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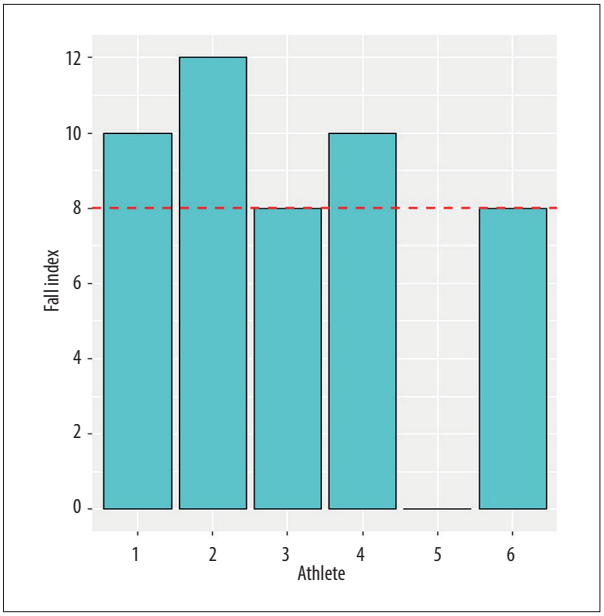

Figure 6. Individual scores obtained in the fall index. The graph shows the individual scores of the 6 athletes, with an average (mean) risk fall score of 8 (red dashed line). Athlete 5, who underwent the intervention, was the only athlete who achieved a score of zero, far from the average of the rest of the athletes, who obtained scores equal or higher than the mean of 8 points (scores between 8 and 12 for the athletes who did not undergo the Atlasprofilax intervention).

(**Figure 4**). To measure the secondary endpoint, several factors were measured, such as the stability index and the weight distribution index (WDI), in relation to various values depending on the position of the head, eyes closed open, among others, giving a final value of fall index. The lower the value of the fall index, the higher the stability and proprioceptive performance of the evaluated participant (**Figure 5**).

Results

The results of the primary endpoint, risk of fall assessment, are shown in **Figure 4**. Athlete number 5, the only one who underwent the Atlasprofilax procedure, 12 days before the balance testing, obtained the best score among the 6 athletes, reaching the most proximal position to the origin of the abscissa and ordinate axis (**Figure 4**). For the secondary endpoint, fall index, athlete 5 obtained the best performance, compared with the other athletes, managing to maintain the minimum value in all the evaluated positions, obtaining the lowest total score, and achieving the best placement among all the evaluated athletes in all tests and values (**Figures 5, 6, Table 2**). No adverse effects related to the intervention were observed.

Table 2 shows that athlete 5, who received the Atlasprofilax intervention, obtained a fall index score of zero, while the other athletes, who did not undergo the intervention, obtained values between 8 and 12.

Discussion

The relevance and relationship of the atlantooccipital hinge and its soft structures to proprioception is well studied [2,31,32]. The proprioceptive role of the posterior rectus muscles of the head is important in posture and balance [33]. Dural infolding through tension in the myodural bridge impacts negatively in proprioception and balance [34]. Although possible subclinical abnormalities in the metabolism of the suboccipital myofascia are not usually examined, they could underlie a decrease in body balance and human proprioceptive ability. Atlasprofilax is a noninvasive device-mediated intervention that uses mechanotransductive vibropercussion, aiming an improvement of underestimated alterations in the suboccipital myofascial [21]. The mechanotransductive mechanism of the Atlasprofilax device could potentially ameliorate not only subclinical metabolic alterations of the suboccipital miofascia but also of the myodural bridge function and its performance. This would biomechanically contribute to improving posture and balance downwardly through the myofascial chains continuum. It is relevant to note that athlete 5, the only one intervened among the 6 members of the Brazilian Olympic archery team, obtained far better scores and performance in proprioceptive and balance skills than the others. Even if we cannot establish a direct correlation between results and intervention, it is possible to suggest a tendency that should be evaluated with a 2-arm study, with pre- and post-intervention measurements and a control group.

A limitation of this study was the small sample size. With a larger number of participants, the statistical significance could determine what this case series can only suggest. A larger study with pre- and post-intervention testing in a larger group of participants and a control group is recommended.

Conclusions

This case series report suggests that the Atlasprofilax intervention could produce positive effects on proprioception, balance, and sport performance in archers. Further studies with a larger sample size could eventually corroborate the trend shown in this case series.

Institute Where the Case Was Treated

Health Institute “Primeira Vértebra”, Belo Horizonte, Brazil.

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Declaration of Figures' Authenticity

The authors of the study confirm that all figures submitted were created by them and that the images are original and not duplicated. The authors confirm that these images have not been previously published in any form. The only exception is Figure 1, which was sourced.

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