

Exercises based on the motor preference of athletes (11-12 years old) from the Rafael Trejo gym

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Abstract

Motor preference is a determining factor in athletic performance and in the design of training methodology adapted to the individual characteristics of athletes, especially in disciplines such as boxing. The functional preference of one side of the body directly influences technique, posture, and combat strategy. The study of laterality patterns at an early age is especially important to optimize the training process of future talents. This research, which aims to create a set of exercises based on the motor preference of boxing athletes (11-12 years old) at the Rafael Trejo Gym, focused on 13 boxers between 11 and 12 years of age, some of whom are new to the sport, while others have a year or more of experience. This age is considered a sensitive period for the development of motor and technical-tactical skills, so the early identification of laterality patterns allows for more precise guidance in the teaching of fundamentals such as guarding, movement, and basic punches. The group's diversity provided a favorable framework for analyzing how different types of laterality (right-handed, left-handed, and cross-handed) manifest themselves and how these influence the assimilation of boxing's technical content. Understanding these patterns from an early age not only facilitated more personalized teaching but also contributed to more effective long-term development.

Keywords: patterns, laterality, boxing, motor preference, exercises.

Introduction

Boxing is a combat sport classified as an opposition sport. Its practice demands not only a high level of physical fitness but also a deep tactical understanding of the fight, where every movement must serve a defensive or offensive purpose.

Boxing comprehensively stimulates both physical (strength, endurance, speed) and coordinative (orientation, balance, reaction) abilities, making it an effective means for the athlete's multifaceted development, especially at a young age. Based on Rather and Morales (2019), we can say that proper technical training from the earliest stages of learning is essential to ensure safe and effective progression. For this reason, factors such as guard position, functional laterality, and motor organization play a fundamental role in training design. Laterality, understood as the functional preference for one side of the body over the other, has a direct influence on how boxing technique is learned and executed, contributing to optimized athletic training. This preference encompasses not only the dominant hand, but also the eye, foot, and spatial orientation of the body, forming a laterality profile that can be homogeneous (all segments are dominant on the same side) or crossed (different parts of the body have opposite dominance).

Laterality allows for orientation in space and time, resulting from the ordered distribution of functions between the two cerebral hemispheres and the way in which they process information. Currently, its study and definition are highly relevant and novel, especially in the field of combat sports. (Iglesias-Soler et al., 2018; Guan et al., 2021; Dopico et al., 2019; Izquierdo and Morales, 2022).

In boxing, handedness primarily determines the choice of stance: right-handed boxers typically adopt an orthodox stance (left hand forward and right hand back), while left-handed boxers use a reverse stance. This decision influences the types of combinations taught, how the opponent is read, and how the boxer moves within the ring. When handedness is mixed, for example, with a dominant right hand but a dominant left eye, challenges can arise in spatial awareness and movement timing, requiring methodological adjustments during training.

In this sense, García et al. (2022) consider that one way to optimize the preparation of athletes in

boxing is by knowing the laterality patterns of successful athletes and contrasting them with the ways of conducting the fight that led them to achieve victory.

Recognizing and working on laterality from the earliest stages of training allows for personalized technical instruction and improves a boxer's performance. It also facilitates the prevention of persistent motor errors and contributes to a balanced development of coordination skills. In this sense, laterality should not be viewed merely as an anatomical feature, but as a key component in sports training planning. To characterize this pattern and subsequently create the exercises, the motor preference test published by Dorochenko (2013) was used, which incorporates tests from various authors such as Solin (1988 and 1990) and Zazzo (2015) that allow for the evaluation of the Dominant Eye-Dominant Hand relationship, Dominant Eye-Dominant Foot relationship, Shoulder Laterality, Hip Laterality, Dynamic Leg, and Dominant Foot.

The exercises designed are justified by the contributions of the authors Badau et al. (2018); Bugallo et al. (2021); González et al. (2019); and Velez et al. (2020). These authors agree that boxers must master both hemispheres of the brain to demonstrate good technical and tactical preparation during combat.

Materials and methods

The first part of the investigation began with the application of the laterality test, which consists of 6 tests, which are explained below.

1. **Measurement of the leading eye**The procedure involves extending your arms and holding a sheet of paper with both hands. In the center of the paper, there will be a hole approximately 0.5 centimeters in diameter. Focus, with both eyes open, through the hole as if aiming at a target a few meters away. Quickly bring the sheet of paper close to your face without taking your eyes off the object. The hole will close in on the dominant eye: Figure 1.
2. **Hand laterality**The hand used for activities such as throwing, writing, combing hair, etc. will be used. Figure 2.



Figura 1. Ojo director



Figura 2. Mano preferida

3. **Shoulder laterality** Standing facing a wall with both hands placed on it, an object (foam ball) is thrown behind the athlete. As the athlete turns to catch it, they must rotate as quickly as possible to reach the object. Note the direction of rotation. Shoulder rightness means rotating from right to left. If the rotation is to the left, the athlete has right shoulder laterality.



Figure 3 *Shoulder laterality*



Figura 4. Lateralidad de cintura

4. **Waist laterality** Standing upright with feet shoulder-width apart and hands on hips, jump while rotating as far as possible, completing a full 360° turn. Note the best direction of rotation. The first direction of rotation is usually the preferred one, but not always; therefore, both directions of waist rotation need to be checked. The preferred direction is more complete and balanced. Right lateral rotation of the waist: preferred left direction of rotation:

5. Figure 4. *Waist laterality*

6. **Dynamic leg** This is the leg we lift to jump. After performing the test on the right side and then the left,

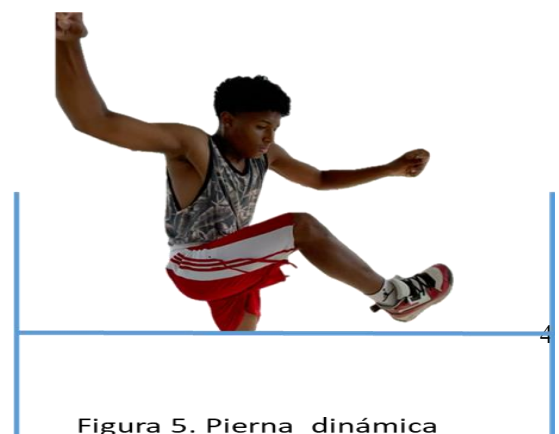


Figura 5. Pierna dinámica

note the preferred side. In contrast to the dynamic leg, the opposite leg is called the supporting leg or the power leg. The dynamic leg is also the leg we use when we want to crush something.

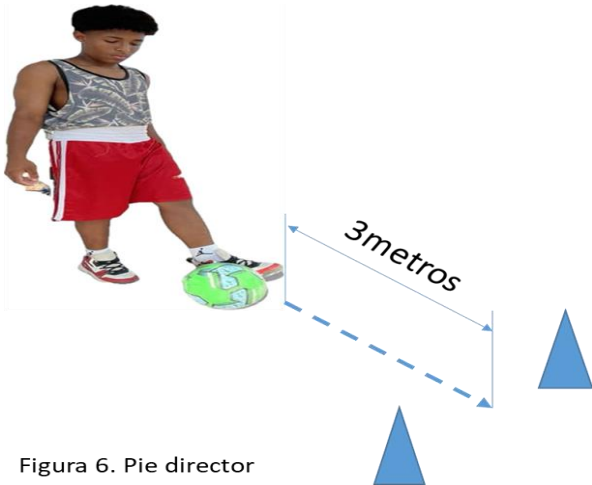


Figura 6. Pie director

7. **Main footer:** is the foot with which we preferentially kick a ball.

After the six tests comprising the laterality assessment were completed, they were evaluated one at a time, and the relationship between the tests was analyzed to better assess each athlete's motor profile and enhance performance. This relationship between tests defines the athlete's profile as homogeneous left, right, or crossed. The relationships between tests

were: dominant hand–shoulder laterality, shoulder laterality–hip laterality, dynamic leg–dominant foot, and dominant eye–hip laterality.

The following form formats were used for data collection.

Table 1.

Sheet 1: characterization of laterality patterns and Sheet 2: individual data with relationship between two tests.

Caracterización de patrones de lateralidad (datos).
Deporte: _____ **Sexo/cantidad:** (/) (/)
Datos individuales por pruebas.
 D: Derecho, I: Izquierdo, A: Ambidiestro.

Individuo	Prueba No. 1 Ojo director.	Prueba No. 2 Mano dominante	Prueba No. 3 Rotación de hombro	Prueba No. 4 Rotación de cadera	Prueba No. 5 Pierna dinámica	Prueba No. 6 Pie dominante
	D I	D I A	D I	D I	D I	D I
%						

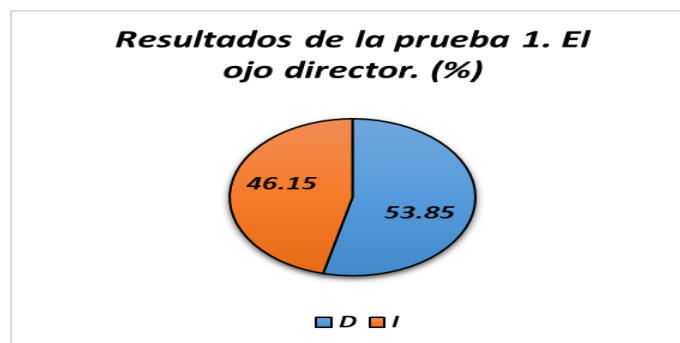
Datos individuales con relación entre 2 pruebas.
 HD: Homógeno Derecho, HI: Homógeno Izquierdo, C: Cruzado.

Individuo	Relación entre pruebas			Relación entre pruebas			Relación entre pruebas			Relación entre pruebas		
	HD	HI	C	HD	HI	C	HD	HI	C	HD	HI	C
%												

Results and discussion

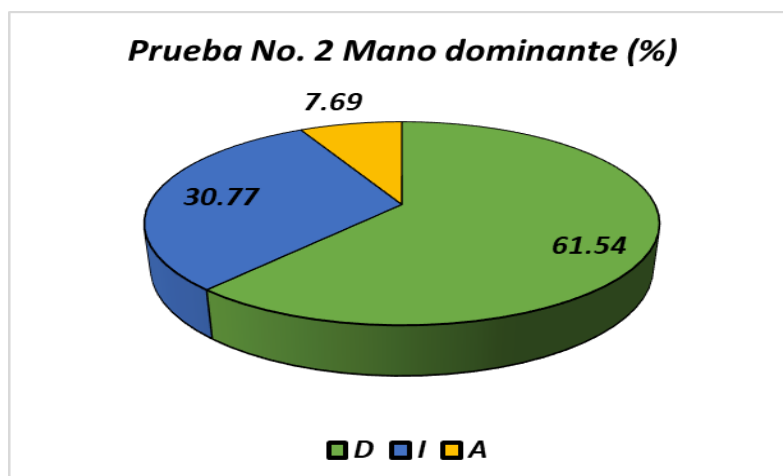
It is important to note that some of these boxers have been practicing for over a year, which may have influenced the observed visual laterality. Constant and repetitive boxing practice, especially under a specific stance like the orthodox guard (with the left hand forward), can condition visual perception and generate a crossing between the dominant eye and the preferred hand. This phenomenon, known as crossed laterality, can develop as a functional adaptation that allows for better spatial orientation and response in combat. Therefore, the distribution observed in this group not only reflects a natural tendency but also possible adjustments acquired throughout training, highlighting the influence of practice time on the development of perceptual-motor skills.

Chart 7. Test results 1. The leading eye.



Legend: R: Right, L: Left.

Chart 8. Test results 2. Hand laterality.



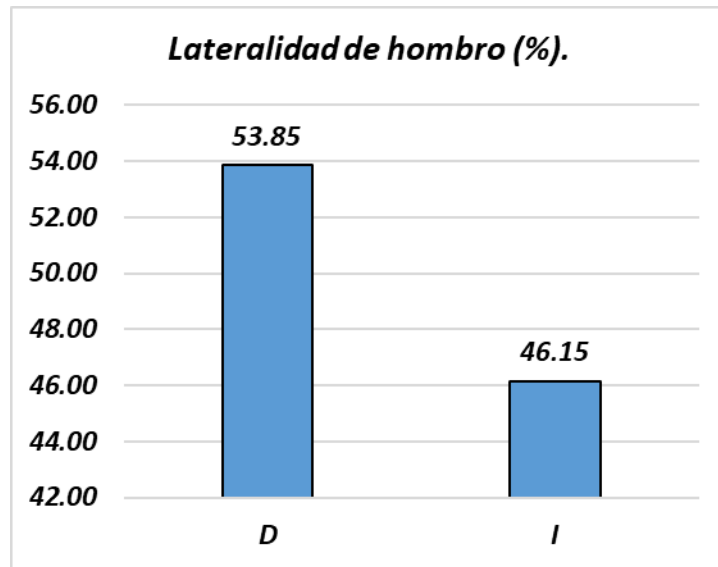
Legend: R: Right in green, L: Left in blue, A: Ambidextrous in yellow.

It's worth noting that the group includes a mix of seasoned and new boxers, so they don't all have the same level of experience in the sport: some are just starting out in boxing, while others have over a year of continuous training. This difference in experience and background can significantly influence the observed handedness. In the more experienced boxers, consistent practice may have led to functional adaptations, such as the strategic use of their non-dominant hand or the development of greater bilateral coordination. For example, some experienced southpaws might train in a right-handed stance to confuse their opponent or enhance their cross, while ambidextrous boxers have a tactical advantage by being able to switch stances naturally during a fight.

On the other hand, newly trained boxers tend to adapt to their natural laterality, which is reflected in a more intuitive execution of movements. In these cases, knowing their dominant hand is essential to guide them in choosing their stance and in designing personalized exercises that promote their gradual adaptation to the sport.

In summary, the analysis of hand dominance in this group of boxers not only allowed us to identify the motor dominance of each one, but also to observe how experience influences the functional use of the hand, generating variations that can have a direct impact on fighting style, tactical decision-making, and overall performance in the ring.

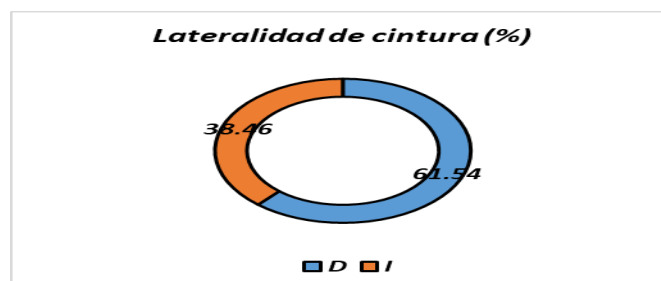
Chart 9. Test results 3. Shoulder laterality.



Legend: R: Right, L: Left.

This laterality refers to the dominant side that guides the rotational movements of the upper body, especially in rapid reaction actions, such as dodging or positioning oneself in response to an unexpected stimulus. In sports like boxing, this pattern can be influenced by experience and the type of stance the athlete has adopted during training. The constant practice of certain movements or dodges can reinforce a rotational tendency, even if it doesn't align with the athlete's natural laterality. Therefore, some variability can be observed in this test, particularly in boxers with more experience, where functional laterality adapts to the technical and tactical demands of the sport. This information is crucial for personalizing training exercises that enhance the effectiveness of movements in real combat situations.

Chart 10. Test results 4. Waist laterality.



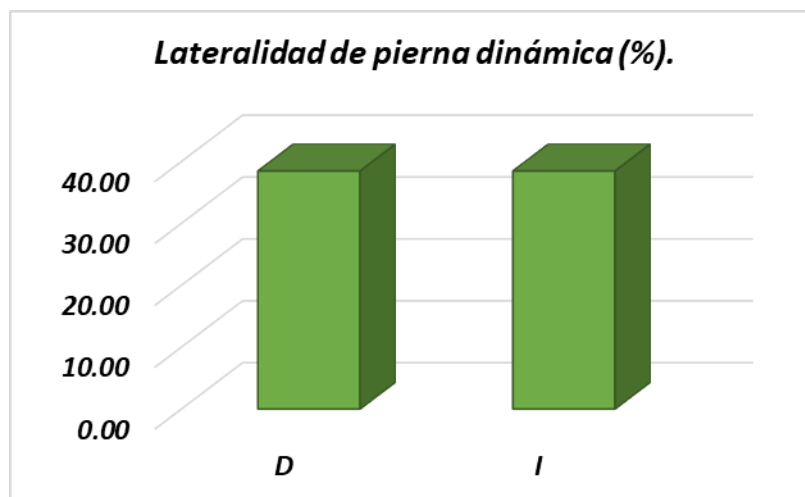
Legend: R: Right blue, L: Left brown.

This test allows you to identify the most natural and balanced direction of trunk rotation, and is especially relevant in sports such as boxing, where body rotation is fundamental for generating power in punches, as well as for defensive movements such as dodging and changing angles.

It was evident that more experienced boxers executed the preferred turn more fluidly, widely, and with greater control, suggesting better development of the motor pattern thanks to repetition and adaptation to the sport's movement. In contrast, some novice boxers exhibited less stable turns or turns with less amplitude, and in certain cases, their natural direction of rotation did not coincide with the most efficient one, highlighting the importance of verifying both directions before establishing definitive laterality.

Sport can significantly influence laterality, as repetitive training movements, such as waist twists for throwing punches or dodging, tend to reinforce a particular rotational tendency, even if it doesn't align with the athlete's original pattern. Therefore, it's crucial to consider both natural preference and acquired adaptations when designing training strategies that enhance individual performance and prevent functional imbalances.

Chart 11. Test 5 result. Dynamic leg laterality.



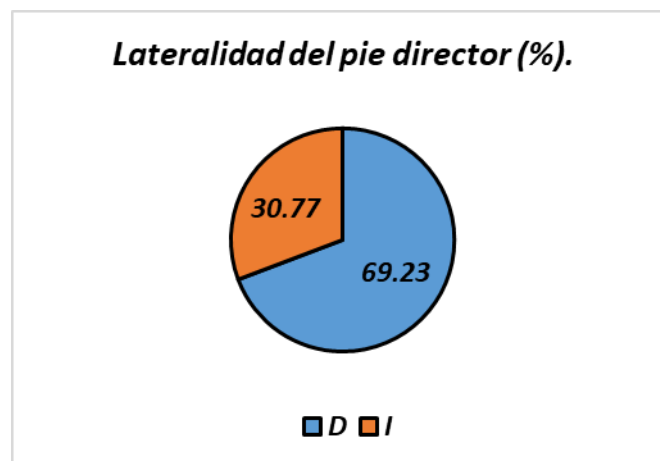
Legend: R: Right, L: Left.

The dynamic leg is the one that is lifted when performing a scissor jump and, therefore, is associated with displacement movements, starting and explosive actions, while the contralateral leg acts as a support or strength leg.

This test allows us to observe not only the student's natural preference but also their coordination, balance, and ability to generate momentum from a stable position. In more experienced boxers, the execution of the jumps showed greater control and symmetry, possibly reflecting a functional laterality reinforced over time through athletic practice. Conversely, some newly trained boxers exhibited clear imbalances when using their non-preferred leg, thus confirming the importance of identifying this pattern to avoid incorrect compensations in more complex exercises.

In the context of boxing, although the dominant leg isn't as prominent as in jumping or running disciplines, it plays a key role in quick movements, dodging, and changes of direction. Furthermore, understanding this laterality helps to adjust strength, coordination, and leg training exercises, respecting the athlete's individual preferences and aiming for balanced development that prevents injuries and enhances their functional performance in the ring.

Chart 12. Test result 6. Laterality of the leading foot.



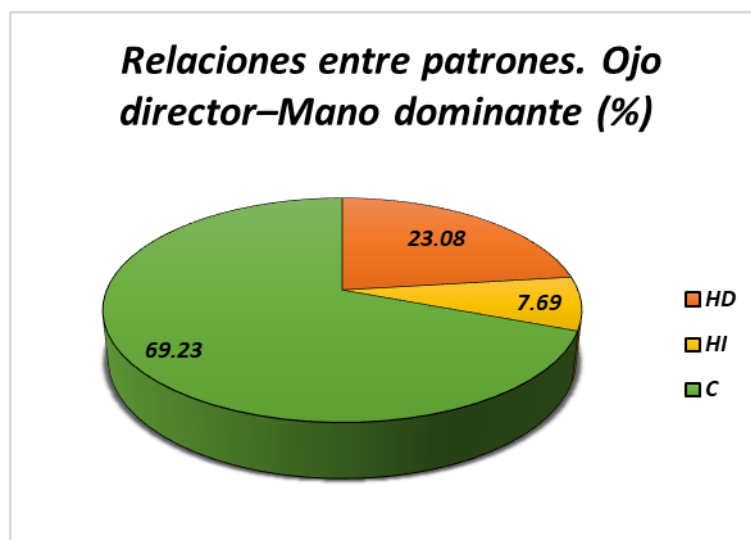
Legend: R: Right, L: Left.

The dominant foot is the one with which a ball is instinctively kicked, and its choice is usually linked to fine motor control and lower body coordination, reflecting a clear dominance in tasks of precision and directed strength.

Although boxing doesn't require actions like kicking, this laterality has significant implications for the sport. The dominant foot can influence how a boxer moves, changes direction, or initiates explosive lower body movements. More experienced boxers showed more decisive and precise

execution of the test, indicating greater development of their dominant movement pattern, possibly reinforced by their regular training. In contrast, some novice boxers exhibited hesitation or less control when using their non-dominant foot, highlighting the importance of understanding this laterality from the early stages of training. Furthermore, identifying the dominant foot allows for adjustments to specific tasks, such as footwork, dodging, or punching from different angles, aiming for balanced and functional lower body development. It is also useful for preventing incorrect compensations or imbalances that can affect posture, base of support, or force transmission during combat movements.

Chart 13. Result of the relationship between tests, relationships between patterns 1. Dominant eye–Dominant hand



Legend: HD: Homogeneous Right, HI: Homogeneous Left, C: Crossed.

This predominance of crossed laterality is especially noticeable among more experienced boxers, suggesting that in addition to a possible natural predisposition, there may also be a functional adaptation generated by the practice of the sport.

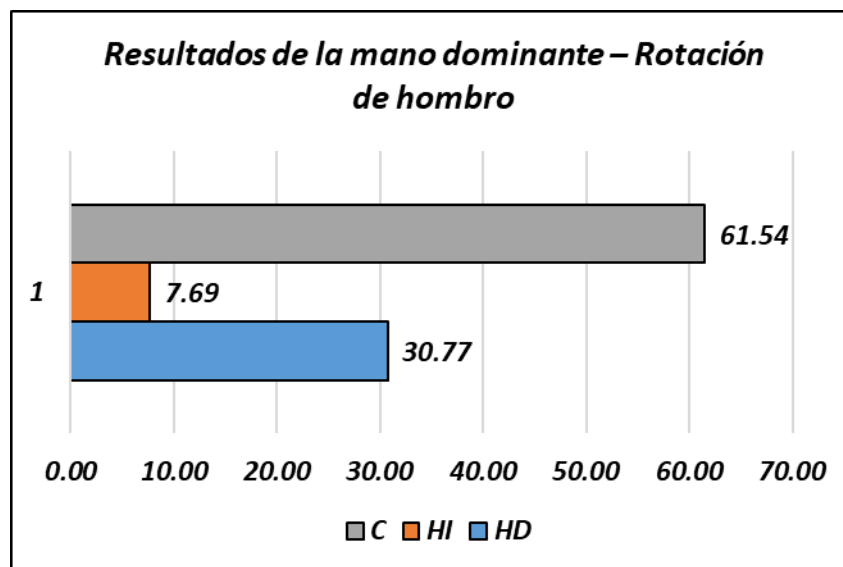
It is noteworthy that, among the newly recruited boxers on the team being studied, only one exhibited crossed laterality, while the others showed a correspondence between hand and dominant eye. This reinforces the hypothesis that continuous exposure to boxing can modify or condition the use of the dominant eye, especially if the boxer has adapted to a stance in which the lead eye does

not coincide with their original dominant eye. Over time, the visual system can adjust its processing to prioritize the eye most useful in combat, generating a phenomenon of functional plasticity.

This change is neither immediate nor universal, but it can be observed especially in athletes who train for extended periods with a specific stance and develop greater visual and motor skills with their lead eye, regardless of their initial dominant eye. In the experienced boxers in the group, this type of adaptation may have contributed to greater perceptual efficiency and improved distance judging and anticipation—key aspects of performance in the ring.

Therefore, the relationship between dominant eye and preferred hand not only reflects an innate condition, but also a capacity for functional adjustment to the sporting environment, which is especially evident in the case of boxing, where visual positioning and body orientation are in constant interaction.

Chart 14. Dominant hand results – Shoulder rotation



Legend: HD: Homogeneous Right, HI: Homogeneous Left, C: Crossed.

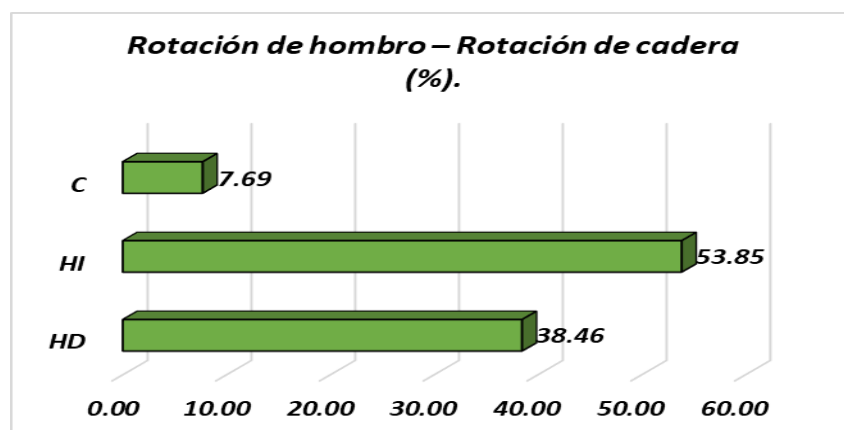
61.53% of the boxers studied showed crossed laterality, that is, their dominant shoulder (the one that rotates first in the test) is on the opposite side to their preferred hand.

This cross-pattern is very common in experienced boxers, since during punches, especially with the rear hand, which is usually the most powerful, a rotation of the shoulder opposite the punching hand is generated to enhance the technique. For example, a right-handed boxer throwing a right straight rotates their left shoulder forward as part of the pre-punch or body adjustment movement. This repeated technique in training and competition can cause the body to adopt this rotational direction as the preferred one, influencing the result in tests such as shoulder laterality.

In the case of boxers with less athletic experience, it was observed that they did not exhibit crossed laterality, with their dominant shoulder coinciding with their dominant hand. This indicates that, in the early stages, rotational movements have not yet been shaped by athletic practice, and the movement reflects a more natural or spontaneous motor preference. As boxing technical training deepens, it is common for this laterality to begin to change through functional adaptation, developing a crossed pattern that better meets the demands of the sport.

This phenomenon is a clear example of how systematic boxing practice can modify initially automatic or natural movement patterns, generating new forms of functional dominance based on technique and the specific demands of the sport. Recognizing this evolution allows for adjusting training to strengthen intersegmental coordination and prevent imbalances in developing boxers.

Chart 15. Shoulder rotation – Hip rotation



Legend: HD: Homogeneous Right, HI: Homogeneous Left, C: Crossed.

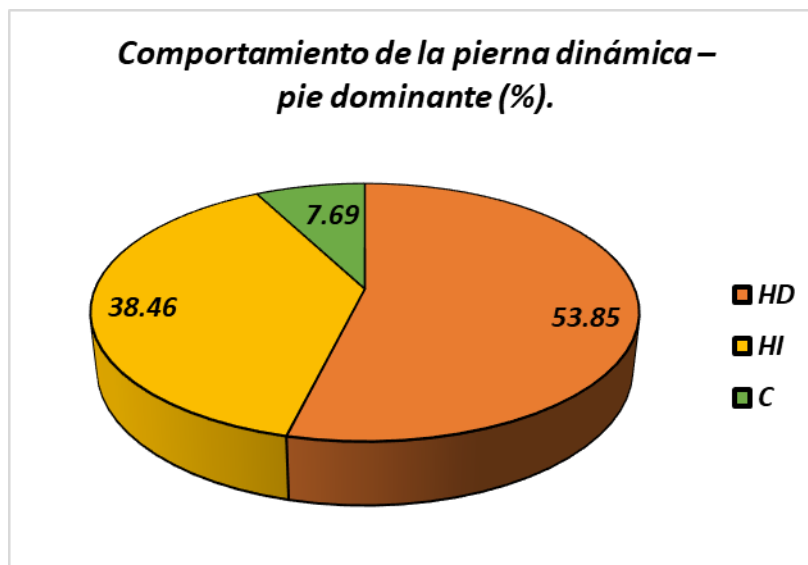
This clear predominance of homogeneous laterality reflects good intersegmental coordination, which is highly functional in boxing. When the shoulder and waist rotate in the same preferred direction, a

fluid transmission of force from the lower to the upper body is facilitated, optimizing the power of punches, especially straight punches and hooks, and improving the efficiency of footwork and dodging.

In more experienced boxers, this consistency is more evident, suggesting that continuous training promotes the consolidation of this efficient motor pattern. In contrast, a student exhibiting crossed laterality may be undergoing an adaptation process or have a different natural predisposition, which could temporarily affect the fluidity of their movements or require more specific work on segmental coordination.

In summary, consistency between shoulder and waist rotation is a positive indicator of a boxer's technical and motor development. Most of the team exhibits this relationship consistently, reinforcing the pattern's functionality and its direct influence on performance in the ring.

Chart 16. Dynamic leg behavior – dominant foot



Legend: HD: Homogeneous Right, HI: Homogeneous Left, C: Crossed.

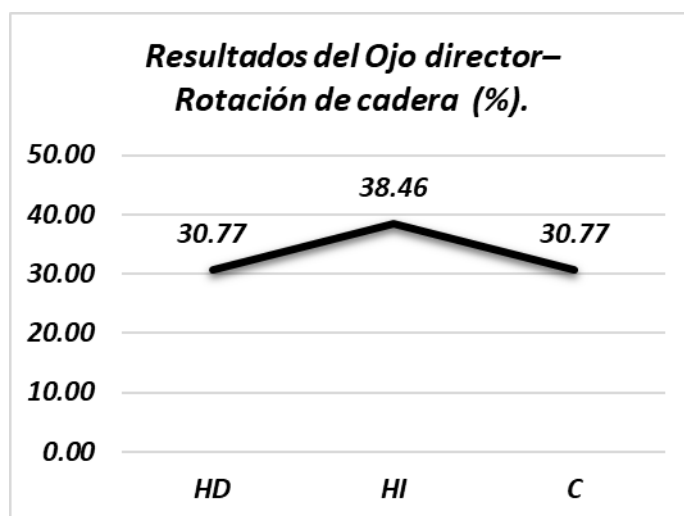
This predominance of homogeneous laterality is consistent with the demands of boxing, where legwork plays a fundamental role in balance, movement, weight transfer, and punch preparation. Having the same leg as the dominant and dynamic leg facilitates greater coordination between

offensive and defensive movements, as well as improving postural stability during lateral or circular movements.

In the case of the student with mixed laterality, it was observed that, although one leg was dominant, in functional actions such as jumping or stepping, the student preferred the opposite leg. This type of pattern may be due to a functional adaptation derived from practice, a developing motor preference, or a natural compensation that, in certain sporting contexts, can even represent an advantage in terms of reaction time or dynamic balance.

Overall, the group showed good correlation between dominant and dynamic leg, which is beneficial for boxing-specific performance, as it provides a solid foundation for footwork, improved execution of dodges with firm support, and greater efficiency when shifting weight onto the supporting leg to throw punches. This analysis also highlights the importance of continuing to develop bilateral coordination to ensure balanced movement, especially in athletes in training.

Chart 17. Results of the Directing Eye – Hip Rotation



Legend: HD: Homogeneous Right, HI: Homogeneous Left, C: Crossed.

Most homogeneous cases reflect a more integrated motor organization, where the dominant visual field coincides with the direction of body rotation, favoring greater fluidity in technical execution and a more efficient connection between perception and action during combat.

However, the four cases of crossed laterality, including two novice boxers, show a different configuration, where the dominant eye and hip are on opposite sides. This type of pattern can emerge

as an individual characteristic, but in less experienced boxers, it could also indicate that their body is still in the process of defining its lateral organization based on boxing techniques. It is possible that, as they adapt to specific training, some of these patterns will be modified or consolidated depending on the functionality they develop.

In more advanced boxers, this cross-laterality is not necessarily a disadvantage; in fact, it can provide tactical advantages such as keeping the dominant eye forward in the guard, improving visual perception of the opponent while the hip rotates to the opposite side to maximize the power of the punch with the trailing hand.

In short, although most of the group tends toward a homogeneous laterality between eye and hip, the presence of crossed patterns—even in novice boxers—reflects motor diversity and the influence of the learning process on the development of these configurations. Detecting these patterns allows the coach to adapt technical training to enhance the boxer's effectiveness according to their lateral profile.

Exercise proposals based on the group's laterality patterns and objectives.

First group of exercises.

Objective: To enhance the integration of homogeneous and crossed lateral patterns.

This objective seeks to develop optimal functional coordination in both athletes with crossed laterality and those with homogeneous patterns, promoting adaptation to real combat situations where different parts of the body intervene in a dissociated or asymmetrical manner.

Individual exercises.

1. Shadow with forced guard change every 30 seconds.
 - Benefit: It forces the athlete to activate both sides of the body and reorganize the coordination between eye, hand and leg in real time.
 - Focus: Directing eye and dynamic leg from alternating guards.
2. Impacts to the mirror with restricted vision.
 - Dynamics: Partially cover one eye to make the boxer adapt with the other side.

- Focus: Stimulates the visual system to develop compensatory adaptations.
3. Mirror combinations (jab, cross, hook) with the non-dominant side.
- Focus: Develop technical control in the secondary hand, useful for cross-handed or left-handed players with a right leg.

Second Group of exercises.

Objective: To improve segmental dissociation (eye-shoulder-hip-leg).

This objective focuses on training the coordination of body axes that in boxing must act independently, but also in sync, especially in cross-body boxers, where the leading eye and rotation segments do not coincide.

Group exercises.

1. Lateral dissociation circuit (station style):
 - Station 1: Shoulder rotation with light weight (alternating direction with each arm).
 - Station 2: Hip rotations with medicine ball.
 - Station 3: Visual work with object tracking (eye-body coordination).
 - Station 4: Jumps with a 180° turn, changing direction each repetition.
 - Focus: Allows independent and coordinated control of each segment.
2. Mirror games in pairs (reverse imitation)
 - Dynamics: One boxer executes combinations and movements and the other imitates them but in the opposite direction.
 - Benefit: Strengthens spatial perception and forces activation of the non-dominant side.

Conclusions

1. Laterality directly influences the technique, coordination, and strategy of young boxers; constant boxing practice can modify natural laterality, generating functional adaptations.

2. A high presence of cross-patterns was identified, especially in more experienced boxers; detecting these patterns from an early age allows for personalized teaching and the prevention of imbalances.
3. The proposed specific exercises enhance the integration of homogeneous and crossed lateral patterns to improve intersegmental coordination and strengthen the non-dominant side, as well as improve segmental dissociation (eye-shoulder-hip-leg), seeking a balanced technical development adaptable to the demands of combat.

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