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Dynamics of changes in time differences and muscle strength in qualified handball students during the academic year

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Abstract
Purpose: It consists in studying during the school year the accuracy of shooting at targets installed in the corners of the gate in a calm position for experienced handball players and in the influence of turning the body in different directions.
Methods: The following methods were used in the course of the study: 1) literary sources, analysis of research papers and scientific articles, scientific research on the topic, scientific and practical experience of foreign and domestic scientists in the field of sports in bund were studied and analyzed. 2) A pedagogical test in which the accuracy of the difference between the time interval and the limit of muscle tension of handball players was controlled. 3) Mathematical and statistical calculation, in which the effectiveness of technical and tactical actions of attacking handball players was calculated mathematically based on the following formula. 4) The study used pedagogical tests developed by us and approved by the Handball Federation of Uzbekistan.
Results: The results of a study conducted on the differentiation of reactions of qualified handball players to the differentiation of balance, time interval and limit of muscle tension are analyzed. It was revealed that the number of accurate reactions performed by the right hand, especially the left, without eye control in the time period associated with throwing the ball into the goal, by the end of the school year, decreases by 2-3 times for all handball players studying at all courses.
Conclusion: During traditional handball training, the ability to maintain balance, time and the necessary stress limit, which are crucial for ensuring the accuracy of the ball in sports, are usually not developed with the help of special exercises. Therefore, handball players who are watched in training, especially during tournament games, more often make mistakes due to a violation of the coordination of balance when throwing the ball into the goal from different distances and flanks.

Keywords: handball players, vestibular analyzer, balance, space-time differentiation, reaction, coordination.

Introduction

To apply a technical and tactical technique to a certain object during a game, a handball player focuses his eyes on the range of movement of this object, the time of execution of the technique applied to it and sends impulses of movement to the corresponding muscle groups. Although the necessary reactions of spatio-temporal differentiation in relation to an object moving in a situation are performed under the control of vision, there are many negative actions associated with "early" or "late". Therefore, the accuracy of time differentiation (aiming) must be formed independently with the help of exercises performed according to the principle of "dynamic stereotype" in various conditions(9,11,8).

Methods

The differences between the parameters of the preparation of the subjects and the average statistical indicator were obtained using statistical analysis using the application "Microsoft office excel". With this approach, indicators of the development of technical training of handball players are clearly defined, taking into account the goals and objectives of the study.

The following statistics were taken into account:

– arithmetic mean;
- dispersion;

Results and discussion

The study was conducted in 2020-2021 among students of 1-4 courses studying at the Uzbek State University of Physical Culture and Sports, majoring in handball.

Studies of qualified handball students in conditions of traditional training have shown that the results of the necessary time differentiation were recorded mainly in the predominance of "early" and "late" reactions, while accurate reactions were relatively less common. (see table 1).

The ability of qualified handball students to distinguish time intervals in ES with eye control with the right hand was 193.5±31.7 m/s in 10 attempts of freshmen at the beginning of the academic year it is characterized by an "early" reaction. However, by the end of the academic year, the level of this indicator increased or deviated from the limit of accurate reaction and amounted to 227.6 ± 45.2 m/s (see table 1).

Table 1. Dynamics of changes in the accuracy of spatio-temporal differentiation of right-handed and left-handed qualified handball students during the academic year

Types of reactions	I year		II year	III year	IV year
Right hand (10 attempts)					
"Early" reactions (m/s)	193.5 ± 31.7 / 227.6 ± 45.2		223.4 ± 46.1 / 239.3 ± 49.5	197.2 ± 35.5 / 235.5 ± 41.6	191.3 ± 31.3 / 252.7 ± 51.6
"Late" reactions (m/s)	215.3 ± 44.5 / 239.7 ± 49.1		237.7 ± 55.3 / 247.5 ± 59.2	207.8 ± 37.8 / 257.6 ± 51.7	201.9 ± 38.7 / 263.5 ± 61.3
Number of accurate reactions (times)	21 / 17		26 / 21	31 / 27	35 / 32
Left hand (10 attempts)					
"Early" reactions (m/s)	327.6 ± 79.1 / 359.3 ± 85.7		366.8 ± 87.7 / 407.5 ± 99.3	351.7 ± 81.5 / 393.6 ± 92.8	338.9 ± 77.6 / 403.7 ± 93.3
"Late" reactions (m/s)	389.7 ± 89.7 / 439.5 ± 97.6		377.7 ± 69.9 / 413.4 ± 87.1	336.5 ± 53.7 / 407.3 ± 69.6	327.7 ± 71.5 / 398.8 ± 51.7
Number of accurate reactions (times)	12 / 8		15 / 7	18 / 10	19 / 13

Note: ES - electrosecondometer;
- numerator - indicators at the beginning of the academic year;
- denominator - indicators at the end of the academic year;
- the tests were conducted 3 times in a row on each year: n=16x3=48.

These indicators in the second year, respectively: 223.4±46.1 - 239.3±49.5 m/s; In the third year - 197.2±35.5 - 235.5±41.6 m/s; In the fourth year - 191.3±31.3-252.7±51.6 m/s presented. "Delayed" reactions in the first year - 215.3±44.5 - 239.7±49.1 m/s; In the second year - 237.7±55.3-248.5±59.2 m/s; In the third year - 207.8±37.8 - 257.6±51.7 m/s; In the fourth year -201.9±38.7 – 263.5±61.3 m/s.

In handball, the number of handball players who took part in studies conducted at the beginning of the school year has increased, which is crucial to ensure the effectiveness of scoring the ball (as well as passing the ball to a partner). At the end of the study, it was noted that while the "early" and "late" reactions were far from the set point of accuracy (zero), the number of clear reactions decreased from the initial values. It is possible that this situation is connected with the workload of annual classes with handball students in the groups "Improving sports and pedagogical skills".

Provided that this test is performed with the participation of the left hand, studies conducted at the beginning of the academic year showed that "early" reactions were demonstrated in all students of the course, first of all, relatively quickly compared to the corresponding indicators recorded at the end of the academic year (reactions in this form were increasingly far from the exact point), secondly, this test was performed twice the time interval from the results of the study, provided that it was performed with the right hand. Although the "delayed" reactions noted at the beginning and end of the academic year were performed in a direction similar to the dynamics of change observed above, their level was higher and decreased from course to course. The accuracy of the left-sided time interval was observed at the beginning and end of the academic year, although it was half the results of the right-sided test, but it increased from course to course with a small difference.

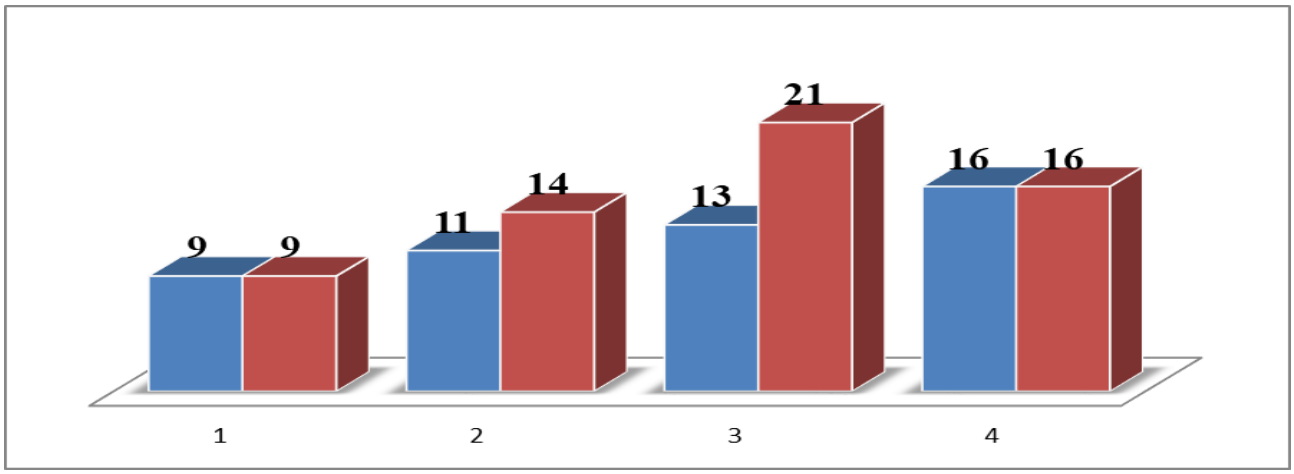
Based on the results of these studies, another problem can be recognized, which is that there is a significant asymmetric difference between the differential reactions of the right and left hands, especially specific reactions, and this difference increases from course to course (see picture 1). Presumably,

During the game, aiming and accurate determination of the time required to throw the ball into the goal (or pass the ball to a partner) is usually carried out under the control of the

eyes. However, as a result of the regular formation of such an ability with the help of special exercises during training, the time interval can be determined in the presence of "muscle memory" (muscle sensation — proprioception) even without vision control. This ability is of paramount practical importance in modern handball and increases the ability to more accurately determine the time when throwing the ball into the goal.

Studies in this regard have shown that the time interval associated with throwing the asymmetric difference noted between the accuracy of the time differential of the right and left hand does not go unnoticed, without adversely affecting the accuracy of scoring the ball with the right and left hand.

the ball into the goal of qualified handball players engaged in traditional training was fixed in the right hand without eye control, especially in the left hand, with a predominance of "premature" and "delayed" reactions, the results of which are much longer than the established exact designation (zero). For example, right-sided temporary "early" differential reactions in first-year handball students averaged 382.3±79.2 m/s at the beginning of the academic year. By the end of the academic year, this indicator slightly decreased or approached the target indicator of clear reactions and amounted to 365.6±71.5 m/s presented (see table 2).



Picture 1. Dynamics of changes (times) during the academic year of the asymmetric difference between the accuracy of the spatio-temporal differentiation of the right and left hands in qualified handball students.

Note: 1-4- courses handball students;
- Asymmetric difference noted at the beginning of the 2019-2020 academic year;
- Asymmetric difference noted at the end of the 2020-2021 academic year.

Note: ES - electrosecondometer;
- numerator - indicators at the beginning of the academic year;
- denominator - indicators at the end of the academic year;
•the tests were conducted 3 times in a row on each year: n=16x3=48.
•It was noticed that the average ranges of "late" differentiated reactions were larger than the

Table 2. Dynamics of changes in the accuracy of spatio-temporal differentiation of right-

Types of reactions	I year	II year	III year	IV year
Right hand (10 attempts)				
"Early" reactions (m/s)	382.3 ± 79.2 365.6 ± 71.5	375.5 ± 76.4 351.2 ± 68.7	363.1 ± 67.4 354.6 ± 65.2	359.3 ± 64.4 349.6 ± 71.5
"Late" reactions (m/s)	416.2 ± 81.5 397.7 ± 77.8	407.5 ± 76.6 391.3 ± 71.7	395.6 ± 72.3 382.4 ± 67.5	383.7 ± 68.4 379.2 ± 62.2
Number of accurate reactions (times)	11 13	14 17	15 19	18 20

Table 2. Dynamics of changes in the accuracy of spatio-temporal differentiation of right-handed and left-handed qualified handball students during the academic year

Left hand (10 attempts)				
"Early" reactions (m/s)	$\frac{419.5 \pm 88.7}{413.2 \pm 88.2}$	$\frac{411.9 \pm 85.6}{410.6 \pm 81.7}$	$\frac{407.7 \pm 83.5}{402.5 \pm 79.2}$	$\frac{401.8 \pm 78.9}{397.6 \pm 84.4}$
"Late" reactions (m/s)	$\frac{434.4 \pm 95.6}{425.5 \pm 91.2}$	$\frac{448.7 \pm 97.1}{441.4 \pm 95.3}$	$\frac{439.2 \pm 92.3}{435.6 \pm 87.7}$	$\frac{436.6 \pm 87.5}{429.5 \pm 83.3}$
Number of accurate reactions (times)	$\frac{3}{4}$	$\frac{4}{5}$	$\frac{7}{8}$	$\frac{9}{11}$

ranges of "early" differentiated reactions. However, the time interval of "early" and "late" differentiated reactions approached the set goal (zero) both at the beginning and at the end of the academic year. For example, the range of "early" reactions recorded at the beginning of the academic year decreased from course to course or from 382.3±79.2 m/s (I course) to 359.3±64.4 m/s (IV course). By the end of the academic year, it was characterized by a further downward trend (365.6±71.5 - 349.6±61.5 m/s).

Although the range of "delayed" reactions received at the beginning and end of the school year for right-sided differentiation without eye control was slightly higher than the target, their decrease from course to course was also detected: from 416.2 ± 81.5 m/sec to 383.7±68.4 m/sec - the dynamics of change at the beginning of the school year; from 397.7±77.8 m /s to 379.2±61.2 m /s - the dynamics of change at the end of the school year.

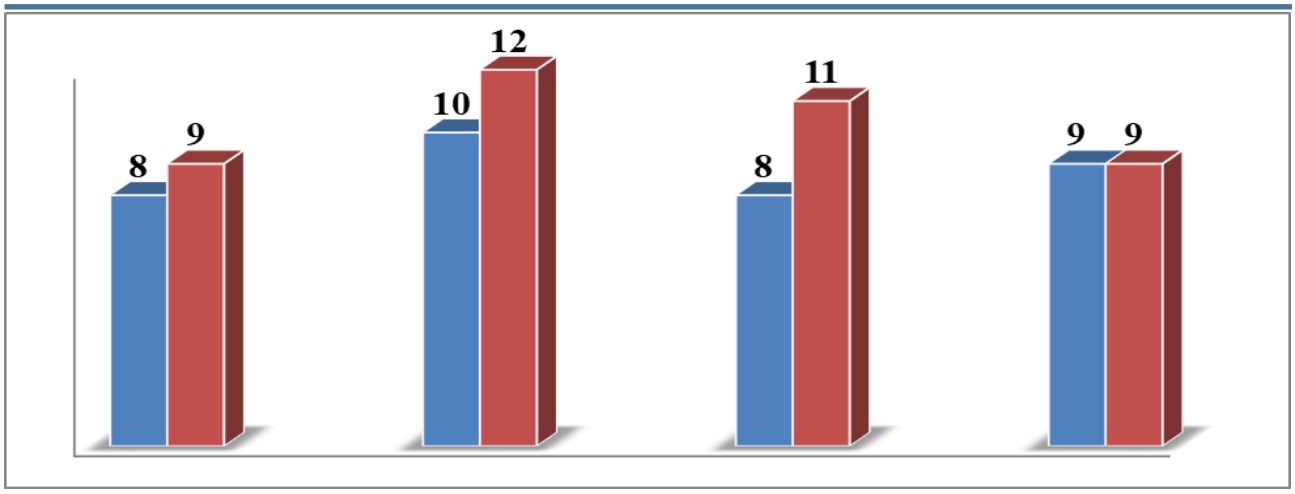
The number of clear reactions received to the differentiation of the time interval of 10 attempts with the right hand without eye control increased from course to course both at the beginning and at the end of the academic year. To a certain extent, this indicates that the accuracy of setting the time interval for handball players is formed during training. At the same time, left-handed differential reactions, especially the number of clear reactions, were observed to decrease by 3.0-3.5 times from the level of the corresponding reactions recorded on the right hand. For example, the number of clear reactions to spatio -temporal differentiation with the right hand was 11, 14, 15, 18 times at the beginning of the academic year and 13, 17, 19, 20 times at the end of the academic year. When distinguishing the time interval with the left hand, clear reactions were manifested in the amount of 3-4, 4-5, 7-8, 9-11 times, respectively.

It can be seen that almost all handball students had a pronounced asymmetric difference between the number of distinct reactions observed on the right and left hand, differentiating both at the beginning and at the end of the academic year, or, in other words, with the left hand. The time differentiation of these handball players is extremely weak until the ability is formed (see picture 2).

Therefore, it should be recognized that the sharp increase in the difference recorded between the accuracy (in number) of the difference in time intervals between the right and left hands without eye control is due to the insufficient formation of integrative capabilities of analyzers (movement, vision, vestibular, tactical analyzers - ririoreceptors, "muscle memory") that control this functional activity.

The level of tension (25 kg) is determined in handball player students who study at different courses and are engaged in groups of "Sports and pedagogical improvement" it was noted that at the end of the academic year, the volume of pronounced reactions with a low number, which manifested themselves in the predominance of "premature" and "delayed" reactions of right and left hand differentiation reactions, increased (slowly) both by the end of the academic year and by the cross-section of the courses. "Early" right-hand tension reactions in first-year students from 18.3±4.27 kg to 18.7±3.19 kg, in the second year from 18.9±3.01 kg to 19.2±3.21 kg, in the third year from 19.5±3.37 kg to 21.4±2.68 kg, in the second year from 20.9 ±3.48 kg to 22.7±3.17 kg did not reach the level of accurate reactions (see table 3).

Note: The test was performed on a dynamometer blindfolded.



Picture 2. Dynamics of changes (times) during the academic year of the asymmetric difference between the accuracy of the spatio-temporal differentiation of the right and left hands in qualified handball students.

Note: 1-4- courses handball students;
- Asymmetric difference noted at the beginning of the 2019-2020 academic year;
- Asymmetric difference noted at the end of the 2020-2021 academic year.

The "Excessive" reactions were manifested as follows: 31,4 ± 3,35 - 30,7 ± 2,93; 29,8 ± 2,46 - 29,2 ± 2,17; 30,3 ± 1,96 - 28,6 ± 2,08; 29,4±2,35 - 27,7±1,85 kg. It can be seen that in all courses, "early" tension reactions tend to increase by the end of the academic year, and "excessive" tension reactions tend to decrease or partially increase stress reactions. However, the exact intensity reactions, if we take into account the number of repetitions of the test and its execution from 10 attempts (in each course: n = 16x3 = 48x10 = 480 times), were very weak in all courses participating in the study. For example, the accuracy of distinguishing a given tension limit (25 kg) with the right hand is the number at the beginning and end of the academic year: in the first year - 13/15; II course - 12/14; III course - 15/18; IV course - March 17/21. However, the low tension reactions registered at the beginning of the school year partially intensified by the end of the school year, which indicates a slow but steady development of this ability. However, this situation cannot be assessed as positive for highly qualified handball players.

It was noticed that the reactions of differentiation of the set tension limit (25 kg)

Table 3. Dynamics of changes in the accuracy of spatio-temporal differentiation of right-handed and left-handed qualified handball students during the academic year.

Types of reactions	I year	II year	III year	IV year
Reactions to the distinction of the tension level in the right hand (10 attempts)				
"Early" tension reaction (25 kg)	$\frac{18.8 \pm 4.27}{18.7 \pm 3.19}$	$\frac{18.9 \pm 3.01}{19.2 \pm 3.21}$	$\frac{19.5 \pm 3.37}{21.4 \pm 2.68}$	$\frac{20.9 \pm 3.48}{22.7 \pm 3.17}$
Reaction to "Excessive" tension (25 kg)	$\frac{31.4 \pm 3.35}{30.7 \pm 2.93}$	$\frac{29.8 \pm 2.46}{29.2 \pm 2.17}$	$\frac{30.3 \pm 1.96}{28.6 \pm 2.08}$	$\frac{29.4 \pm 2.35}{27.7 \pm 1.35}$
Pure tension reactions (times)	$\frac{13}{15}$	$\frac{12}{14}$	$\frac{15}{18}$	$\frac{17}{21}$

Table 3. Dynamics of changes in the accuracy of spatio-temporal differentiation of right-handed and left-handed qualified handball students during the academic year

Reactions to the distinction of the tension level in the left hand (10 attempts)				
"Early" tension reaction (25 kg)	$\frac{14.7 \pm 4.25}{15.5 \pm 3.77}$	$\frac{16.3 \pm 3.91}{17.8 \pm 3.01}$	$\frac{17.7 \pm 4.11}{18.6 \pm 3.25}$	$\frac{18.2 \pm 4.03}{19.5 \pm 2.62}$
Reaction to "Excessive" tension (25 kg)	$\frac{32.4 \pm 2.24}{31.9 \pm 2.48}$	$\frac{32.7 \pm 3.16}{31.3 \pm 3.05}$	$\frac{31.9 \pm 2.82}{29.7 \pm 2.75}$	$\frac{32.8 \pm 3.37}{30.6 \pm 2.18}$
Pure tension reactions (times)	$\frac{5}{6}$	$\frac{7}{9}$	$\frac{6}{8}$	$\frac{9}{11}$

with the left hand were recorded in a very negative position compared to differential reactions of the same tension level. In particular, the "early" tension reactions of first-year handball players from the set tension limit (25 kg) during the academic year from 14.7±4.75 kg to 15.5±3.77 kg, in the second year - 16.3±3.91 kg to 17.2±3.01 kg, in the third year - from 17.7±4.11 kg to 18.6±3.25 kg, in the fourth year - from 18.2±4.03 kg to 19.5±2.62 kg.

The "excessive" reactions registered in the differential-tension movements of the left hand were characterized by the following dynamics of change, respectively: I course - 32.4 ± 2.24 - 31.9 ± 2.48; II course - 32.7±3.16 - 31.3±3.05; III course - 31.9±2.82 - 29.7±2.75; IV course - 32.8±3.37-30.6±2.18 kg.

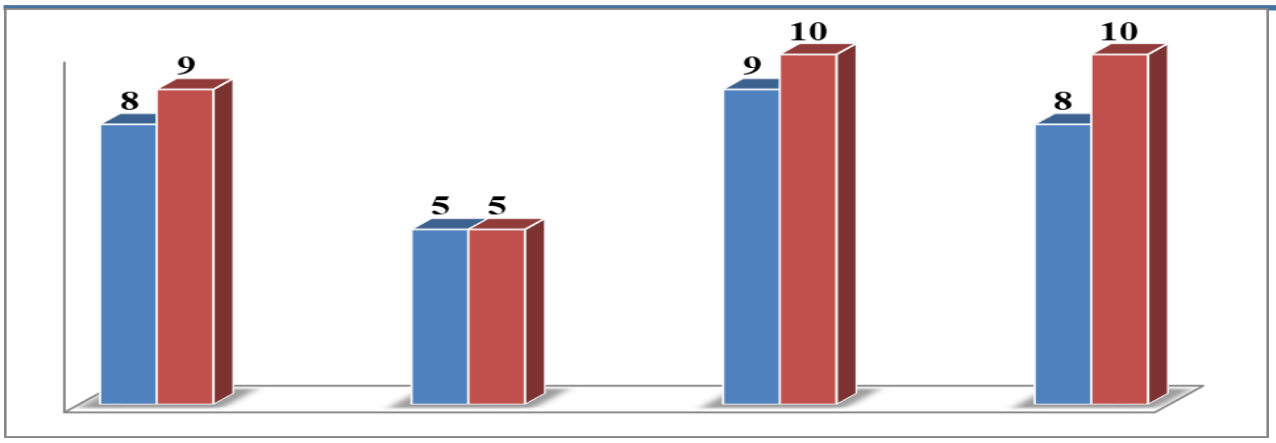
It was noted that the number of reactions to the exact differentiation of the tension limit (25 kg) in the left hand was 1.5-2.5 times lower in almost all students of the handball course: changes in the exact stress reactions during the academic year: in the first year - 5-6; II course - 7-9; III - 6-8; In the IV course - 9-11 times. Although initially pronounced stress reactions were expressed at the end of the academic year and during the course with positive dynamics of change, there was no significant asymmetric difference between the exact reactions performed with differential movements of the right and left hands in these handball players (see figure 3). The practical significance of such an ability lies in the fact that a handball player can accurately target the time needed to accurately throw the ball into a stationary (for example, a goal) or moving (goalkeeper, opponent) object, but the stress limit required to play them with the right and left hand is the same, the inability to distinguish inevitably negatively affects the accuracy of the ball.

Conclusion.

To substantiate the tasks of research and the choice of methods of analysis and generalization of data from literary sources, the literature on the following branches of science has been studied: special literature on the theory and methodology of physical education, pedagogy and psychology, anatomy, physiology, biomechanics, mathematical statistics. and handball, more than 100 scientific research papers, experiments of scientists have been studied.

The results of pedagogical observations show that during traditional classes with handball students in this sport, the ability to maintain balance, time interval and differentiate the necessary stress limit is not regularly developed, which is crucial in ensuring the accuracy of throwing the ball into the goal. it is formed with the help of special exercises. Therefore, handball players who are watched in training, especially during tournament games, often make mistakes due to a violation of balance coordination when throwing the ball into the goal from different distances and flanks. The fact that such coordination abilities are not formed with the help of special exercises was confirmed by the results of a study conducted among these handball players.

In these handball players, there was an asymmetric difference between the reactions of the spatio-temporal differentiation of the right and left hands under eye control, and without eye control. When differentiating the time intervals, the "early" and "late" reactions of the left hand were recorded 1-2 times longer than the reactions of the right hand. Although the exact number of reactions observed in the time



Picture 3. Dynamics of changes (times) of asymmetric difference indicators observed during the academic year between the accuracy (quantity) of differentiation of the set stress level in the right and left hand of qualified handball students.

Note: 1-4- courses handball students;

- Asymmetric difference noted at the beginning of the 2019-2020 academic year;

- Indicators recorded at the end of the 2020-2021 academic year;

interval differential was also performed to a lesser extent on the left hand, it was found that the number of such reactions increased from course to course. At the same time, it was found that the number of clear reactions performed with the left hand by the end of the school year among handball players studying at all courses decreased by 2-3 times. It was found that the reactions to the differentiation of the tension limit (25 kg) installed in the manual dynamometer were carried out in exactly the same direction as the dynamics of the above indicators.

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muscle strength, handball, handball's rules, culture and sport.

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