# Motor coordination, visual function and functional/ sensory vision training system for volleyball sport

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PhD, Associate Professor **M.Kh. Khaupshev**[1]
PhD, Associate Professor **A.Z. Bazhev**[1]
**A.A. Bazhev**[1]
PhD, Associate Professor **V.M. Musakaev**[2]
[1]Berbekov Kabardino-Balkarian State University (KBSU), Nalchik
[2]Kabardino-Balkarian State Agrarian University named after V.M. Kokov (KBSAU), Nalchik

Corresponding author: haupshev-m@mail.ru

**Abstract**

**Objective of the study** was to test and analyze benefits of a new visual function / motor coordination training system for volleyball players.

**Methods and structure of the study.** We run a yearly test of the visual function / motor coordination training equipment at volleyball sports schools of Kabardino-Balkarian State University and Kabardino-Balkarian State Agrarian University. We sampled for the tests the 9-10 to 19-20 year-old volleyball players (n=208) split up into six Reference Groups (RG) and six Experimental Groups (EG). The sample progress was tested by the direct/ feedback visual function and technical and tactical action accuracy tests.

**Results and conclusion.** Special trainings have proved to contribute up to 30-50% in the visual function / functional vision progress, although the traditional training systems never offer training equipment with a feedback capacity for the data flow accuracy control.

The experimental visual function / motor coordination training system for volleyball players was tested highly beneficial for harmonized motor coordination / visual function progress in the Experimental group versus the traditional training system. The new training technology effectively facilitated the visual function / technical and tactical action progress as verified by the individual progress profiles and databases. We recommend the new visual function / motor coordination training system and test data for application in volleyball training service.

***Keywords:*** *volleyball practices, visual function, motor coordination, training complex, health agenda.*

**Background.** The visual function and motor coordination training elements in modern volleyball are always relevant for the players' game control and responses that need to be accurate, timely and highly efficient. Volleyball trainings give a special priority to visual function and functional vision i.e. controlled responses in the 'eye-hand, eye-ball, eye-partner' systems. Every action will start from the target being visually fixed in the premotor phase when the response is planned. Special accuracy trainings will develop movement phasing skills starting from the premotor phase for the motor skill stability and success. The visual function is undoubtedly critical for the sport-specific accurate movement controls and, therefore, need to be in special priority in the motor coordination training service elements [1-6, 11].

Motor coordination in the context of the special technical and tactical skills has been studied by many researchers. Volleyball is known to improve the visual function and functional vision in trainings due to the heavy flows of the game data need to be processed by the visual analyzer in rapidly changing game situations. Volleyball players would develop special functional vision with the feel of the court, partner, ball, net, distance, opponent, etc. These sensations tend to excel with trainings and competitions and sag in the idle periods [2, 4, 7, 9, 10, 12].

The visual function - functional vision excelling elements are relatively challenging for the traditional training systems, with the best alternative provided by the training equipment compliant with the K.K. Platonov's training simulator theory [8] and

I.P. Ratov's training machine assisted sports motor skill theory [9], and the V.S. Farfel's instant data flow processing principles [10].

Objective of the study was to test and analyze benefits of a new visual function / motor coordination training system for volleyball players.

Methods and structure of the study. We run a yearly test of the visual function / motor coordination training equipment at volleyball sports schools of Kabardino-Balkarian State University and Kabardino-Balkarian State Agrarian University. We sampled for the tests the 9-10 to 19-20 year-old volleyball players (n=208) split up into six Reference Groups (RG) and six Experimental Groups (EG). The sample progress was tested by the direct/ feedback visual function and technical and tactical action accuracy tests.

Results and discussion. Modern volleyball training systems give a special priority to sensory systems dominated by the visual function / functional vision excellence elements, with the motor skill known to be 50-70% dependent on the visual function / functional vision. Special trainings have proved to contribute up to 30-50% in the visual function / functional vision progress, although the traditional training systems never offer training equipment with a feedback capacity for the data flow accuracy control. For visual function / motor coordination progress, the volleyball training systems need to offer combined special signals to train perceptions, motor skill biomechanics, speed and accuracy on a harmonic basis. Such trainings will be focused on the visual signal perception, processing and response i.e. choice of the right 'action program' to attain the goal by special coordinated motor skill. Figures 1 and 2 hereunder give the data flow processing channels for the traditional and experimental motor coordination training models.

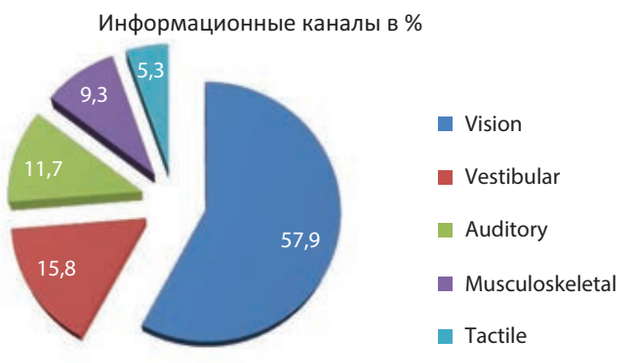


**Figure 1.** *Data flow processing channels (%): traditional volleyball training system*


**Figure 2.** *Data flow processing channels (%): experimental volleyball training system*

We tested the group progress by the Response to Moving Object (RMO) test; electronic reflexometer; peripheral (external, upper, lower) visual function by ophthalmic perimeter; binocular (in depth) visual function by the horizontal and linear perimeter visual function tests; and the technical and tactical action accuracy by UMV-2 system using the wall and floor targets. The test tools, methods and rating criteria have proved reliable and objective. The group pre-experimental tests found no significant EG/ RG differences ($p1 > 0.05$). The progress tests found insignificant ($p2 < 0.05$) progress in the RG and significant ($p2 < 0.01$) progress in the EG. The post-experimental tests found significant ($p3 < 0.05$) progress in the EG versus RG: see Table 1.

The motor skill / technical and tactical action accuracy showed little progress in the RG ($p2 < 0.05$), versus significant progress in the EG ($p2 < 0.01$). The post-experimental tests found significant ($p3 < 0.05$) progress in the EG versus RG. The yearly experimental model resulted in significant progress in the EG ($p2 < 0.01$) see Table 2.

The group progress in the visual function components and motor coordination showed high effectiveness of the tests, with $rtk = 0.3 > 0.6$ that meets recommendations of well-known scientists. The tests made it possible for us to profile the age group progress. Figure 3 gives the visual function progress test data ($p < 0.05$) and technical and tactical action accuracy test data for the EG ($p < 0.01$). Note the direct high correlation ($r=0.531>0.786$) of the visual function and technical and tactical action accuracy test rates – indicative of the high visual function contribution to the technical and tactical action accuracy.

**Table 1.** *Group visual function test data*

| Tests | Group | Age subgroups, years | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 9-10 | | 11-12 | | 13-14 | | $p_2$ |
| | | $M_1 \pm m_1$ | $M_2 \pm m_2$ | $M_1 \pm m_1$ | $M_2 \pm m_2$ | $M_1 \pm m_1$ | $M_2 \pm m_2$ | |
| Target shooting accuracy | RG | 41,4±1,6 | 45,7±1,6 | 53,2±1,6 | 59,4±1,6 | 57,4±1,6 | 60,7±1,6 | <0,05 |
| | EG | 42,2±1,6 | 51,3±1,6 | 53,6±1,6 | 67,2±1,6 | 58,3±1,6 | 68,3±1,6 | <0,01 |
| RMO | RG | 43,3±3,7 | 45,4±3,7 | 48,6±3,7 | 54,3±3,7 | 52,1±3,7 | 56,4±3,7 | <0,05 |
| | EG | 42,3±3,7 | 49,9±3,7 | 50,2±3,7 | 61,1±3,7 | 53,0±3,7 | 61,4±3,7 | <0,01 |
| Peripheral visual function | RG | 44,3±1,2 | 46,5±1,1 | 49,1±1,2 | 53,1±1,2 | 52,1±1,2 | 55,1±1,2 | <0,05 |
| | EG | 44,1±1,2 | 51,8±1,2 | 50,1±1,2 | 60,3±1,2 | 52,3±1,1 | 61,2±1,2 | <0,01 |
| Binocular visual function | RG | 46,3±1,3 | 48,4±1,3 | 49,1±1,2 | 54,9±1,3 | 51,2±1,2 | 55,8±1,3 | <0,05 |
| | EG | 46,6±1,2 | 52,4±1,3 | 49,2±1,2 | 60,7±1,3 | 52,3±1,3 | 61,8±1,2 | <0,01 |
| | | 15-16 | | 17-18 | | 19-20 | | $p_2$ |
| Target shooting accuracy | RG | 62,2±1,6 | 66,0±1,6 | 66,1±1,6 | 70,9±1,6 | 69,4±1,6 | 73,2±1,6 | <0,05 |
| | EG | 62,6±1,6 | 71,9±1,6 | 67,4±1,6 | 75,8±1,6 | 70,6±1,6 | 78,4±1,6 | <0,01 |
| RMO | RG | 54,2±3,7 | 58,3±3,7 | 57,3±3,7 | 61,2±3,7 | 60,6±3,7 | 66,4±3,7 | <0,05 |
| | EG | 55,4±3,7 | 64,0±3,7 | 58,2±3,7 | 63,8±3,7 | 62,3±3,7 | 71,4±3,7 | <0,01 |
| Peripheral visual function | RG | 54,9±1,2 | 58,3±1,3 | 57,6±1,2 | 64,2±1,2 | 60,5±1,3 | 64,6±1,3 | <0,05 |
| | EG | 54,9±1,2 | 63,5±1,3 | 58,1±1,3 | 65,2±1,3 | 60,7±1,3 | 70,5±1,3 | <0,01 |
| Binocular visual function | RG | 53,7±1,3 | 58,8±1,2 | 58,3±1,3 | 63,4±1,2 | 62,0±1,3 | 67,2±1,3 | <0,05 |
| | EG | 54,9±1,2 | 63,9±1,2 | 59,4±1,2 | 68,9±1,3 | 63,0±1,3 | 73,7±1,3 | <0,01 |
| Significance rate | | p1>0,05 | p3<0,05 | p1>0,05 | p3<0,05 | p1>0,05 | p3<0,05 | |

**Table 2.** *Group technical and tactical action accuracy test data*

| Tests | Group | Age subgroups, years | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 9-10 | | 11-12 | | 13-14 | | $p_2$ |
| | | $M_1 \pm m_1$ | $M_2 \pm m_2$ | $M_1 \pm m_1$ | $M_2 \pm m_2$ | $M_1 \pm m_1$ | $M_2 \pm m_2$ | |
| Attack | RG | 22,0±4,4 | 27,7±3,9 | 25,8±3,9 | 33,5±3,4 | 28,6±3,8 | 34,3±3,0 | <0,05 |
| | EG | 22,1±4,3 | 31,8±3,2 | 23,8±3,9 | 40,0±2,9 | 28,9±3,8 | 37,8±3,1 | <0,01 |
| Defense | RG | 18,4±3,7 | 22,7±5,4 | 20,8±3,2 | 27,6±3,8 | 23,2±3,3 | 29,1±3,8 | <0,05 |
| | | 17,8±3,9 | 26,8±5,4 | 20,5±3,2 | 32,9±3,6 | 23,0±3,3 | 34,0±3,9 | <0,01 |
| | | 15-16 | | 17-18 | | 19-20 | | p2 |
| Attack | RG | 31,2±3,5 | 37,3±3,8 | 34,3±3,1 | 40,6±2,9 | 38,2±3,1 | 43,9±2,9 | <0,05 |
| | EG | 31,7±3,5 | 42,2±3,2 | 35,2±3,1 | 47,3±2,9 | 38,5±3,1 | 50,2±2,9 | <0,01 |
| Defense | RG | 26,0±3,0 | 31,1±3,9 | 28,6±2,8 | 34,8±3,8 | 31,7±3,3 | 37,3±3,8 | <0,05 |
| | | 25,6±3,2 | 34,4±3,9 | 28,1±2,8 | 39,9±3,9 | 31,0±3,1 | 41,5±3,6 | <0,01 |
| Significance rate | | p1>0,05 | p3<0,05 | p1>0,05 | p3<0,05 | p1>0,05 | p3<0,05 | |

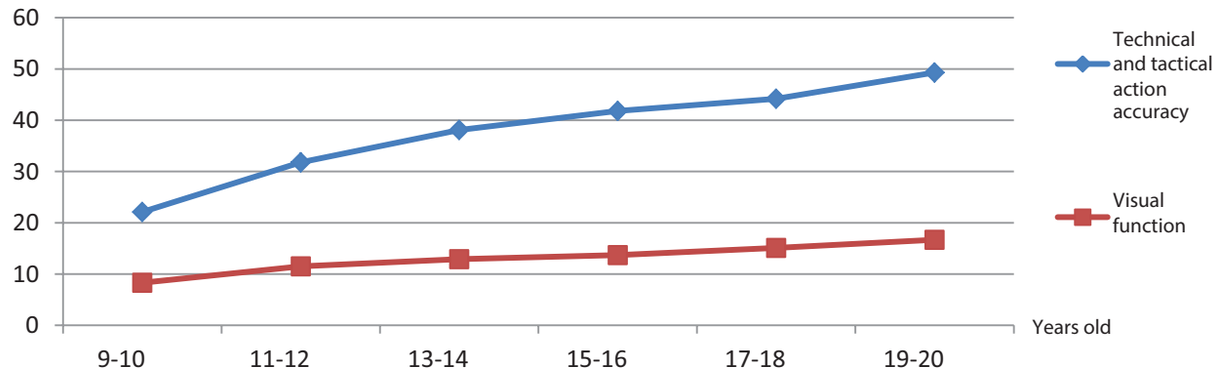


**Figure 3.** *Age-specific progresses in the visual function and technical and tactical action accuracy for the EG*

**Conclusion.** The experimental visual function / motor coordination training system for volleyball players was tested highly beneficial for harmonized motor coordination / visual function progress in the EG versus the traditional training system. The new training technology effectively facilitated the visual function / technical and tactical action progress as verified by the individual progress profiles and databases. We recommend the new visual function / motor coordination training system and test data for application in volleyball training service.

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