



## Anatomical, Physiological, And Biomechanical Review Of Overhead Passing Skills In Volleyball Among The Sparta FIKK UNM Team

Andi Atssam Mappanyukki<sup>1\*</sup>, Nurul Fadilah Aswar<sup>2</sup>, Sarifin G<sup>3</sup>

<sup>1,2,3</sup> Faculty of Sports and Health Sciences, State University of Makassar

Email: [andi.atssam@unm.ac.id](mailto:andi.atssam@unm.ac.id)

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### ABSTRACT

Overhead passing requires coordinated positioning, control of the upper and lower limbs, and adjustment of movement to the incoming ball. This study aimed to describe overhead passing movement assessments from anatomical, physiological, and biomechanical perspectives among players of the Sparta FIKK UNM volleyball team. A descriptive observational design was used with 20 players. Data were collected through direct observation, coach-completed checklists, and photographic documentation. The checklist grouped movement indicators into anatomical, physiological, and biomechanical domains, with suitable and unsuitable response categories. Data were analyzed using frequencies and descriptive percentages. The anatomical summary contained 18 suitable assessments (90.0%) and two unsuitable assessments (10.0%). The physiological summary contained 15 suitable assessments (75.0%) and five unsuitable assessments (25.0%), while the biomechanical summary contained 16 suitable assessments (80.0%) and four unsuitable assessments (20.0%). The equal-weight mean of the three domain percentages was 81.7%. Under the operational rubric, the anatomical score was very good, whereas the physiological, biomechanical, and overall summary scores were good. Item-level observations indicated scope for improvement in trunk control, limb coordination, and adjustment of body position. These results describe checklist-based movement assessments rather than direct measurements of muscle activity or joint mechanics. Several indicators require refinement to distinguish overhead passing from forearm passing. More specific criteria and observer-reliability testing are needed to strengthen subsequent technical evaluation.

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### Corresponding Author:

Andi Atssam Mappanyukki

Faculty of Sports and Health Sciences, State University of Makassar

Email: [andi.atssam@unm.ac.id](mailto:andi.atssam@unm.ac.id)

## 1. INTRODUCTION

Upper passing links the reception of the ball to the arrangement of attacks in the game of volleyball. Successful movement requires body placement, hand control, and adjustment of thrust to get the ball to the target. The study of biomechanics shows the involvement of the wrist and elbow through movement coordination and the use of the stretch-short cycle of the wrist flexor muscle (1). Therefore, the assessment of the upper passing needs to pay attention to the sequence of movements that make up the passing result, not just the direction of the end of the ball.

The demands of motion also change according to the distance of the pass. Analysis of the upper passing at different distances showed that the contribution of the limb increased when the ball needed to be sent further (2). Other research on the flow of energy between joints shows the importance of regulating the upper limbs at short and medium distances and the involvement of the lower limbs at longer distances (3). Both findings place the upper passing as whole-body coordination, with task-dependent needs.

In coaching, the anatomical approach helps to observe the arrangement of body segments and joint movements. The physiological approach provides a framework for understanding the coordination of muscle work and the motion control system, while biomechanics examines the relationship between body



position, balance, and force exertion. At the field observation level, the three frameworks need to be translated into clear indicators. Observable assessments should be distinguished from explanations of biological mechanisms that require specific measurements.

Balance and the ability to adjust positions are an important part of receiving and directing the ball. Research on upper passing skills in a school environment shows the relevance of balance, agility, and motivation to exercise to skill variation (4). Although the school context is different from that of the student team, attention to coordination and movement readiness is still useful as a basis for evaluation. Each team needs information about the aspects of movement that are already consistent and the parts that still need to be directed in the exercise.

The use of skill instruments requires validity and reliability that are in accordance with the objectives of the assessment. The development of basic volleyball skill tests shows the importance of examining the relationship between scores, the objectivity of the assessor, and the repeatability of results (5). The development of a Game Performance Assessment Instrument-based instrument also shows the need to test the content and consistency of assessments in the context of volleyball learning (6). A good instrument helps coaches link the results of observations with traceable practice decisions.

The Sparta FIKK UNM team became the context of this study to describe the movement of the upper passing skill through three groups of aspects. We assessed the suitability of the movement using direct observation and the trainer's checklist. The purpose of the study was to describe the percentage of suitability in the aspects of anatomy, physiology, and biomechanics, as well as to recognize the parts of the movement that require attention. The research was directed at descriptive evaluation as a basis for improving observation and technique practice.

## 2. IMPLEMENTATION METHOD

### *Design and research subjects*

The research used an observational descriptive design. The subjects of the study were 20 volleyball players of the Sparta FIKK UNM Team in the BKMf Volleyball environment, Makassar State University, Makassar. Observations were made on the implementation of the upper passing. The research unit was the players; the assessment of three aspects came from the same group of players. The literature review was used as a basis for the interpretation of movement.

### *Instruments and data collection*

The instrument is in the form of an observation guideline sheet with a selection of appropriate and inappropriate options. The trainer fills out a checklist based on the implementation of the movement. Supporting equipment includes notebooks, stationery, and cameras for documentation. Data collection combines direct observation with recording results and implementation documentation. Figure 1 shows the implementation of the upper passing test in the field.



**Figure 1. Implementation Of The Upper Passing Test And Recording By Observers In The Field.**

**Source: Research Documentation.**

Indicators are grouped into anatomy, physiology, and biomechanics. The anatomy group contains the position and motion of body segments, including the gaze, stumps, arms, and legs. The physiology group

contains the interpretation of the coordination of muscle work in preparation, execution, and advanced movement. The biomechanics group contains body position, weight point adjustment, and balance when responding to a ball. The name of the aspect is used within the scope of the observation guideline.

Conformity is assessed against the indicators on the checklist. Physiological scores are observers' assessments of movement coordination. The study did not use electromyography, metabolic measurements, or nerve activity examinations. Camera documentation was used to record execution and did not produce measurements of joint angle, force, or ball speed. This operational definition is the basis for limiting the interpretation of scores to field observations.

#### **Data analysis**

The main analysis used a recapitulation of the suitability of each aspect on 20 players. The corresponding and non-corresponding frequencies are presented together with the percentages, which are calculated as frequencies divided by 20 and multiplied by 100. The overall descriptive average is calculated from the percentage of anatomy, physiology, and biomechanics of equal weight. The summary does not add up to the number of players to 60 and is not used as an independent observation for statistical testing.

The interpretation of categories used observational operational rubrics. The interval of 88–100% was considered very good, while 71–87% was considered good. Both intervals included all aspect scores and averages obtained. Comparisons between aspects were descriptive. No difference test, relationship analysis, or causation conclusions were drawn.

Item analysis complements the aspect summary by showing indicators that still have inappropriate ratings. Breakdowns only use items with the number of appropriate and inappropriate frequencies equal to 20. A recap of the sideways weight shift item has an amount that is inconsistent with the number of players, so it is not included in the item breakdown. The aspect recapitulation is presented separately so that the main summary and the indicator review are not considered the same measure.

### **3. RESULTS AND DISCUSSION**

#### ***Assessment results by aspect***

The results showed that the anatomical aspect had a corresponding frequency of 18 out of 20 assessments or 90.0%, while two assessments or 10.0% were included as inappropriate. The percentage was in the very good category according to the operational rubric. The physiological aspect had 15 assessments of conformity or 75.0% and five of the non-conforming or 25.0%. The biomechanics aspect had 16 assessments of conformity or 80.0% and four of the nonconforming or 20.0%. The last two aspects were in the good category. A summary of the results is shown in Table 1.

**Table 1. Recapitulation Of Motion Suitability According To Observation Aspects**

| Aspects                   | According to (n) | Not suitable (n) | Suitability (%) | Category  |
|---------------------------|------------------|------------------|-----------------|-----------|
| Anatomy                   | 18               | 2                | 90,0            | Excellent |
| Fisiologi                 | 15               | 5                | 75,0            | Good      |
| Biomekanika               | 16               | 4                | 80,0            | Good      |
| Three-dimensional average | —                | —                | 81,7            | Good      |

Note: each aspect uses the same 20-player denominator. Overall average =  $(90 + 75 + 80)/3$ . Categories are predicates according to the operational rubric of observation; physiological values are not a direct measure of muscle activity.

The average percentage of all three aspects was 81.7%, which was in the good category. The anatomical percentage was 15 percentage points higher than physiology and ten percentage points higher than biomechanics. The difference between physiology and biomechanics was five percentage points. These figures illustrate the difference in recapitulation on the instruments used; the study did not test the statistical significance of the difference.

#### ***Indicators that need attention***

A review of the item shows that some parts of the movement are not fully suitable. In anatomy, the position of the upright and relaxed stand when adjusting the ball from above has 18 appropriate and two inappropriate assessments. In physiology, the control of the strike to avoid bending too much has two



inappropriate assessments. Leg coordination in preparation, leg coordination during extension, and shoulder and arm coordination when reaching for the ball in front each have one inappropriate assessment. A breakdown of indicators with a consistent number of responses is shown in Table 2.

**Table 2. Indicators That Still Contain The Assessment Do Not Match**

| Aspects     | Observation indicators                                                 | According to (n) | Not suitable (n) | Suitability (%) |
|-------------|------------------------------------------------------------------------|------------------|------------------|-----------------|
| Anatomi     | Upright and relaxed strike position when adjusting the ball from above | 18               | 2                | 90,0            |
| Fisiologi   | Leg coordination to maintain bent knees                                | 19               | 1                | 95,0            |
| Fisiologi   | Control the check to avoid too much bending                            | 18               | 2                | 90,0            |
| Fisiologi   | Coordination of the limbs during extension movements                   | 19               | 1                | 95,0            |
| Fisiologi   | Shoulder and arm coordination when reaching for the ball in front      | 19               | 1                | 95,0            |
| Biomekanika | Relaxed arm posture with elbows bent for balance                       | 18               | 2                | 90,0            |
| Biomekanika | Shift of the weight point when stepping backwards                      | 19               | 1                | 95,0            |

Note: each row has 20 responses. Breakdown is limited to items with a consistent number of responses. The frequency between items is not summed as a different number of players.

In biomechanics, a relaxed arm posture with elbows bent for balance has two mismatch ratings. A shift in emphasis when stepping backwards has one mismatch rating. A single player can get a mismatch rating on more than one indicator. Therefore, the number of mismatches between items is not added up to determine the number of players who have difficulties.

#### ***Interpretation of anatomy and coordination of motion***

A high anatomical score indicates that many of the body segments' positional and movement assessments have met the guidelines. In top passing training, positional readiness helps players position themselves before making contact with the ball. However, scores in the indicator group do not in themselves explain the accuracy of the pass. Body position and success in directing the ball are interrelated outputs but need to be judged by their respective size.

Movement assessment needs to pay attention to the relationship between preparation, performance, and advanced movement. The overhead pass study showed elbow and wrist coordination and the utilization of elastic energy in the wrist flexor muscle (1). The study used an analysis of muscle movement and activity so that it provided more specific information than the field checklist. The results of this study can be used to identify the parts of motion that need to be observed in more detail, while the mechanism of muscle work still requires appropriate measurements.

The percentage in the physiological aspect was the lowest compared to the other two aspects. Operationally, the results were related to the observer's interpretation of leg coordination, strike control, and shoulder and arm movement. These findings provide a direction for evaluating coordination in exercise. The percentage of 75.0% does not describe the magnitude of muscle activation, nerve efficiency, or physiological capacity of the player because these variables are not directly measured.

#### ***Interpretation of biomechanics and task requirements***

A biomechanics score of 80.0% indicates that most of the balance and position adjustment assessments have complied with the guidelines. Inappropriate assessments of arm stance as well as point of emphasis displacement can be a concern when a player moves towards the ball. Balance is understood as the ability to maintain body readiness while adjusting steps. Details of force and mass center displacement cannot be determined from the checklist score.

Limb involvement needs to be considered alongside the purpose of the pass. Ozawa and colleagues showed differences in limb motion as the upper passing distance increased (2). Dong and colleagues also



showed changes in the contribution of limb movements based on the distance of the pass (3). Both studies support the need to record tasks clearly in the evaluation of techniques, such as target distance and approach form. This study has not compared multiple distances so the results cannot be used to establish a distance adjustment pattern in Spartan players.

#### ***Implications for practice and assessment improvement***

The results of the observation can be used by the coach to determine the focus of the briefing in the next session. A consistent body position can be maintained, while strike control, leg coordination, and step adjustment can be re-examined when the player is passing. A clear demonstration provides a reference to the movement before the player attempts. A systematic review of observational learning supports the use of movement examples in physical education, taking into account the characteristics of the participant and the task (7).

Feedback should refer to indicators that can be observed and associated with the result of the pass. For example, the coach can discuss the position of the body when receiving the ball and then observe the direction and accuracy of the pass. The study of feedback shows its relevance for the learning of movement skills (8). The form of the exercise is a suggested implication of the observation results; its effectiveness in the player being studied has not been tested through the treatment of the exercise.

Improvement of the instrument becomes a necessity before the score is used for broader technical decisions. The development of volleyball instruments by Jariono and colleagues examined the validity, objectivity, and reliability of test results (5). Dewanti and colleagues also conducted validity and reliability assessments for instruments that were appropriate to the learning context (6). Applicable principles are to establish clear indicators, align indicators with target techniques, and test consistency between assessors.

#### ***Limitations of the study***

The most important limitation lies in the specificity of the content of the observation guidelines. Some indicators of ball possession use the forearm and more closely resemble a lower pass. This condition limits the validity of the interpretation of the score as a special measure of upper passing possession. The indicator needs to be reviewed against the characteristics of the ball contact through the hands above the head before the instrument is used for a more rigorous assessment of the technique.

In addition, the names of physiological and biomechanical aspects include interpretations that cannot be fully measured through visual observation. The reliability between assessors, the consistency of repeated measurements, and the suitability of scores with the accuracy of the feed have not been tested. Details of the number of experiments and target conditions also need to be standardized. Therefore, the good or very good category is limited as a predicate according to the observation rubric, with the need for further verification before being used as a validated measure of skill.

The scope of the study was limited to 20 players from one team and one observation period. The study did not assess changes after practice or performance in the game. The recapitulation of items was also not entirely consistent, so the analysis of the indicators was limited to the number of responses that could be interpreted. Subsequent research needs to improve the content of the guidelines, standardize test procedures, involve trained assessors, and link the assessment of the movement process to the size of the pass result.

## **4. CONCLUSION**

A descriptive assessment of 20 players of the Sparta FIKK UNM Team resulted in anatomical suitability of 90.0%, physiology 75.0%, and biomechanics of 80.0%. The average of the three percentages was 81.7%. According to the operational rubric, anatomy was in the very good category, while physiology, biomechanics, and overall summary were in the good category. Parts of motion that require attention include strike control, limb coordination, and body position adjustment.

These results provide an initial overview of the motion assessment through a checklist. The specificity of the upper passing indicator and the consistency of observations need to be improved so that the score can support the evaluation of the technique more strongly. Testing the validity of the content, the reliability between the assessors, and the relationship between the scores and the accuracy of the pass are needed in the next development.

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