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【Original investigation】

Sports Court-Based Camera Calibration Technique for Three-Dimensional Reconstruction of Knee Joint Kinematics

Issei Ogasawara[1], Yoshio Koyanagi[2]

Abstract

Videos of sports injuries provide beneficial insight for understanding their mechanisms. Recently, video analysis of actual injuries is particularly focused upon by researchers studying the anterior cruciate ligament (ACL). It is expected that establishing a technology capable of quantifying 3D knee kinematics using accidentally filmed videos of injuries could further our understanding of the ACL injury mechanism. The purpose of this study was to validate a camera calibration technique using sports court geometries to establish a methodology to extract 3D knee joint kinematics from uncalibrated video sequences. Four cameras were calibrated using line intersections and the vertical goal mouth of a handball court. A 1.6-m scaling pole, goniometer-embedded link model, and jump-landing motions were filmed, and those 3D kinematics were reconstructed via the direct linear transformation method. The reconstructed values were compared with direct measurements and marker-based motion capture data to assess the accuracy of the reconstruction. Inter- and intra-operator differences were quantified to evaluate the objectivity and reliability of the technique. The length errors ranged from 0.65 to 1.7 cm and angular errors were 1.67°-3.90°. Knee flexion/extension was most accurately reconstructed (errors: 2.71°-4.25°), and the knee adduction/abduction showed moderate accuracy (errors: 3.13°-5.35°). The axial rotation showed large errors of 5.02°-6.53°. Although some limitations exist, the error ranges were small relative to those of previously reported knee displacements during actual ACL injury. Therefore, this technique can be used to quantify knee kinematics from uncalibrated video sequences with reasonable precision.

Key words: direct linear transformation method, three dimensional knee kinematics, anterior cruciate ligament injury, camera calibration

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Ⅰ. Introduction

Several approaches have been employed to investigate the biomechanical factors underlying sports injuries such as motion analysis of maneuvers mimicking injurious situations[1–3], cadaver experiments[4, 5], and computer simulations[6, 7]. Video analysis of actual injury situations has recently been recognized as an effective methodology to quantify an injured athlete's motion, because it is free from ethical issues or restrictions of direct measurements during real sports events.

Technical aspects of video analysis for sports injuries have been developed and utilized, especially in studies aimed at identifying the mechanisms of noncontact anterior cruciate ligament (ACL) injuries[8–11]. In the early stages of the development of video analysis, Olsen[11] evaluated the injured knee joint configuration based on experts' subjective judgment. This study outlined the mechanism of ACL injury, and the results were considered somewhat objective; however, they were not sufficient [12]. Hewett et al.[8] processed still images of ACL injuries and suggested that the combination of the lateral trunk and knee abduction motion contributes to increasing ACL injury risk, particularly in females. Krosshaug and Bahr[12] developed a video processing technique for quantifying the time history of 3D knee joint kinematics from multiple video data. Based on this technique, Koga et al.[13] reported that a complicated 3D mechanism (i.e., combination of tibial internal rotation and abduction relative to the femur) occurs during ACL injury.

To reconstruct 3D knee kinematics from multiple video data, known geometric information must be simultaneously filmed in the background of the video. Sports court lines are strong candidates for such calibration references, because most of video sequences capture the court lines along with the injured athletes. Moreover, the geometry of sports courts is easily referenced in rulebooks. The idea of court-based camera calibration is itself not novel[14], and widespread applications have been developed using the court-based camera calibration technique such as real-time overlaying of the graphics for a soccer pitch[15], detecting the specific location of a football pitch[16], and obtaining 2D[16, 17] and 3D[18, 19] trajectories of players and balls on a court. However, to the best of our knowledge, no studies have validated the use of a sports court as a camera calibration object for reconstructing detailed knee joint kinematics. Krosshaug et al.[20] used court geometry to reconstruct 3D knee kinematics in their application study. However, because their technique was not validated using a real sports court[12], the potential of the court-based reconstruction of 3D knee kinematics remains unknown.

Therefore, in this study, we aimed to assess the precision of reconstruction of human knee kinematics using the court-based camera calibration technique to establish a methodology for investigating the mechanism of ACL injury. A team handball court was used because ACL injuries are common among handball players[21]. Moreover, because there are sufficient planar reference points around the area where injuries are most likely to occur (i.e., the area between the goal and free throw area lines), successful reconstruction of 3D knee kinematics is expected. In this study, the following points were specifically investigated.

1) To validate the accuracy of the court-based camera calibration, 3D motions of known artificial objects (a scaling pole and a link joint model) were computationally digitized, and the errors were evaluated by comparison with direct measurements. This procedure allowed us to validate the reconstruction accuracy by eliminating the human error arising from manual digitization. One concern for the handball court was that the only available vertical reference points were the mouths of the goals, which were fixed at the both ends of the court. We also investigated whether the small number and the uneven distribution of the vertical reference points would cause differences in the reconstruction accuracy between different areas.

2) To quantify the errors in reconstructed knee kinematics, the manually digitized kinematic data were compared with data obtained using the marker-based optical motion capture system.

Ⅱ. Materials and Methods

A. Experimental setting and data recording

An officially certified handball court was used. Before the experiment, court geometry accuracy was verified using a laser distance meter (Leica DISTO D8, Leica Geosystems, Heerbrugg, Switzerland), and we confirmed that the largest deviation from the rulebook was <1 mm in length and <0° in angle. Thus, we considered our court to be applicable as a calibration object. The origin of the court coordinate system was defined at the right-side corner (Figure 1). The three orthogonal axes were defined as follows: the x-axis pointed to the left, the y-axis pointed backward, and the z-axis pointed upward. The planar reference points were defined as follows: two corners (1, 2): the midpoint of the goalkeeper's line (3), the midpoint of the 7-m throw line (4), and evenly spaced segments of the free throw area line (5–67). The vertical reference points (G1–G34) were defined as the boundaries between the red and white strips painted on the goal mouth. Camera Nos. 1 and 2 (SONY HDR-XR560, Resolution: 1920 × 1080, Sampling rate: 30 Hz, Noninterlaced; Sony Corp., Tokyo, Japan) were located on the extension of the center line and 2 m outside of the side line. Distance from the goal mouth was 23.3 m. This camera position was usually used to film the handball games because the both courtside can be filmed evenly. Video recordings of the sports injuries are generally accidental events, thus we consider it is important to use usually used camera positions to evaluate the court-based camera calibration technique. Camera Nos. 3 and 4 were located at 10 m from the end line and 2 m outside of the side line. This camera position was also well accepted to film the games because the conflict between offense and defense is performed around the free throw area line. All cameras were firmly fixed 5 m above from the court level so as to cover the two court corners, goal mouth, and all segments of the free throw area line. This

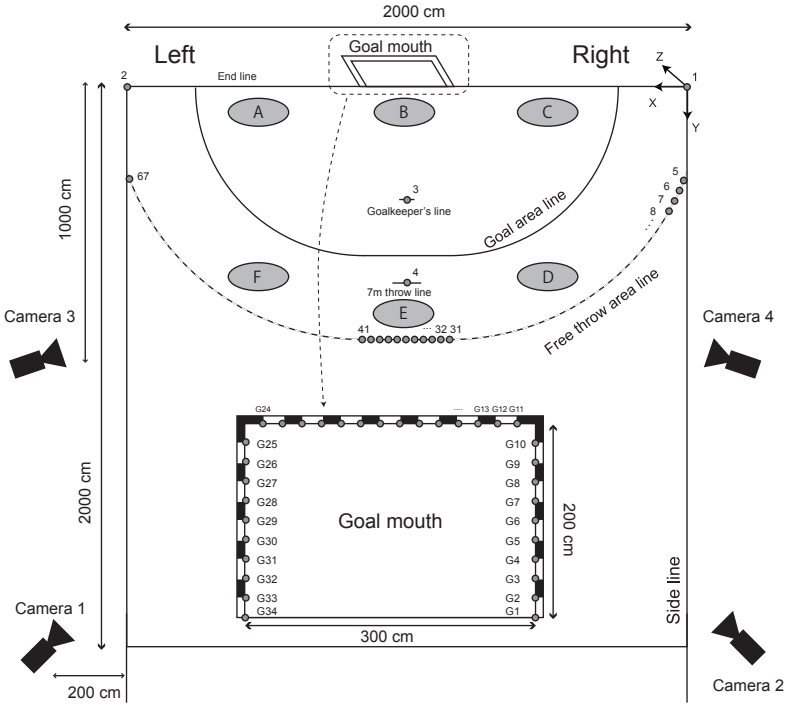


Figure 1 The experimental settings and reference points on the handball court.

The origin of the court coordinate system was defined as the right-side corner. Two corners (1, 2), the middle of the goalkeeper's line (3), the middle of the 7-m throw line (4), and every dot on the free throw area line (5–67) were designated as planar reference points. The color boundaries of the goal mouth were designated as vertical reference points. Trials for the scaling pole and link model were conducted at locations A–F (gray shaded circles).

camera height corresponds to the camera viewing from the spectator seat.

B. Trial

1. Length trial with a scaling pole

A scaling pole (Figure 2A) comprising two black markers 20 cm in diameter was filmed while an operator moved it along the x-axis of the court coordinate system (from left to right) at approximately 1 m/s. The inter-marker distance was 1.6 m. Ten trials per 6 different locations (locations A–C were near and D–F were far from the vertical reference points) were performed to investigate whether uneven distribution of the vertical reference points influences the accuracy of the reconstruction (Figure 1).

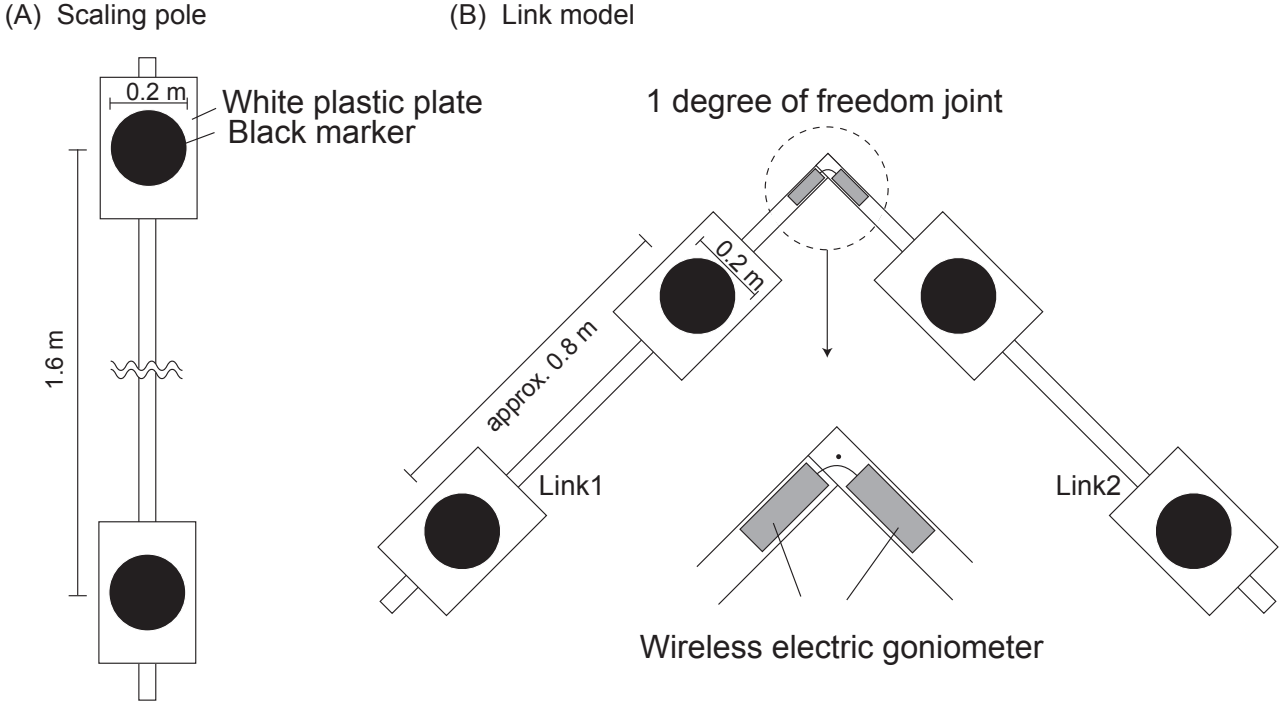


Figure 2 The artificial objects used for length and angle trials

(A) The scaling pole had two black markers of 20-cm diameter. The inter-marker distance was 1.6 m. (B) A goniometer-embedded link model. Each link had two markers.

2. Angle trial with a link joint model

The reconstruction accuracy in the angle was assessed using a custom-made, two-link joint model (Figure 2B). Two markers were attached to each link to specify the joint altitude in the camera images. The operator rotated the joint at approximately 60°/s and filmed the joint at locations A–F. Note that as the orientation of the joint model was always along the x-axis of the court coordinate system, the joint altitude with respect to the optical axis of each camera varied depending on the location (A–F). In particular, at D and F, the joint rotation direction became nearly parallel to the optical axes of cameras 1 and 3, respectively, and the accuracies were expected to decrease. A wireless electric goniometer (ZB-154H, NIHON KODEN, Tokyo, Japan) embedded at the joint was used to measure the true angle at 1-kHz sampling frequency. The cameras were synchronized by capturing the light-emitting diode (LED) light onset. The goniometer data were measured together with the analog signal from the LED light to synchronize the video data.

3. Knee joint kinematics trial

A healthy, right-handed female handball player participated in the experiment. Written consent was obtained from the participant before the trial, which was approved by the local ethics board. The reflective markers were attached at the following

landmarks: tip of the big toes, medial and lateral malleolus, tibial tuberosity, medial and lateral femoral epicondyles, frontal aspect of the thigh, great trochanter, and the anterior and posterior superior iliac spine. After capturing the static calibration trials, the subject performed ten jump shots at location E and was filmed by four cameras. In addition, the trajectories of the reflective markers were captured using an optical motion capture system (Opti Track, 6×S250e cameras, resolution: 832 × 832, sampling rate: 30 Hz; NaturalPoint, Inc., OR, USA) for comparison with the court-based camera calibration.

C. Data processing

To determine the objectivity and reliability of our technique, two operators (OpA and OpB) processed all datasets twice for length, angle, and knee kinematics trials. OpA was a senior biomechanics researcher who was familiar with the manual digitization of human motion. OpB was a graduate student who was less experienced in digitizing human motion.

Lens distortions were corrected by a previously described method 15. The image coordinates of the reference points were obtained using the custom-made LabVIEW script within the Vision Development Toolbox (National Instruments Corporation, TX, USA). First, the movie data were converted from the RGB to binary images with the function (Threshold2), and the position of the pixels with high contrast (e.g., white court lines on a dark background or black markers attached to the artificial objects] were identified. The court lines were then detected by the Hough transform, and the image coordinates of the court corners were obtained by computing the line intersections. The positions of the planar reference points were obtained by computing the center of mass of the pixel groups of each segment of the free throw area line. The image coordinates of the vertical reference points were obtained by identifying the boundaries of the striped pattern on the goal mouth. As observed from this image processing procedure, all image coordinates of the reference points were obtained computationally. To obtain the direct linear transformation (DLT) parameters for each camera, the DLT method was applied to the image coordinate set and the corresponding known 3D coordinates. These DLT parameters achieved small mean standard deviations (SDs) of 0.57 (0.55) cm, 1.13 (1.07) cm, and 0.27 (0.33) cm for the x-, y- and z-directions, respectively, between the positions of the reconstructed reference points and the known 3D coordinates.

The image coordinates of the markers attached to the artificial objects were also digitized computationally, and 3D positions were computed with the DLT reconstruction. The positional data were smoothed with the second-order, low-pass, zero-lag digital Butterworth filter with 6-Hz cut-off frequency. Subsequently, the inter-marker distance and the angle between the links were calculated.

To calculate the knee joint kinematics, the following anatomical landmarks were manually digitized: left and right sides of the great trochanter; the center of the hip, knee, and ankle joints; and the distal tip of the big toes. To determine the shank and thigh segment orientation, the lateral femoral epicondyles and lateral malleoli were also digitized. Subsequently, the DLT reconstruction was applied to obtain the 3D coordinates of the landmarks.

Based on the marker-based motion data, the positions of the centers of the joints were also calculated. The center of the hip was estimated according to the method of Bell et al.[22]. The center of the knee joint was defined as the mid-point of the medial and lateral femoral epicondyles and 2.5 cm distal of the lateral femoral epicondyle[23]. The center of the ankle was defined as the mid-point of the medial and lateral malleoli and 1 cm distal of the lateral malleolus[23]. The 3D positions of the joint centers were smoothed with a second-order, low-pass, zero-lag digital Butterworth filter with 12- and 10-Hz cut-off frequencies for the vertical and

horizontal components, respectively.

Based on the 3D positions of the joint centers, three-link kinematic models of lower limbs were defined for each camera calibration technique. The segment coordinate system for the thigh and shank was defined as follows: the z-axis represents the longitudinal axis pointing upward, the y-axis represents the axis pointing laterally and perpendicular to the z-axis, and the x-axis was a cross-product between the y- and z-axes pointing forward. To describe the 3D knee joint kinematics, the joint coordinate system 24 was applied. The time window of interest began 1 s before and ended 1 s after the first foot impact during single leg landing from the handball player's jump shot.

D. Error evaluation and statistical analysis

To evaluate the effect and interaction of the unevenly distributed vertical reference points and the objectivity (inter-operator difference) and reliability (intra-operator difference) of the technique, mixed design analysis of variance (ANOVA) with two within-subject factors (location (A–F) and processing session (first and second processing)) and one between-subject factor (operators (OpA and OpB)) was conducted using the data obtained from the length and angle tests. The dependent variables were the root mean square (RMS) errors in length and angle between the court-based technique and direct measurements. If any factors were found to have a noticeable effect, a post-hoc Tukey Honestly Significant Difference test was employed to determine statistical significance. The significance level was set at $P < 0.05$. For knee joint kinematics, the errors were presented as RMS errors and maximum differences between the court- and marker-based methods throughout the trial.

Ⅲ. Results

A. Errors in length and angle tests

The ANOVA test revealed no significant interactions among the three factors (operators, locations, and processing sessions) for both length and angle tests. For the length test, only the locations had a significant effect ($F = 46.6$, $P < 0.01$). The post-hoc test showed that locations A–C, which were near the vertical reference points, showed significantly smaller errors than locations D–F (Table 1). These results indicate that the distance from the vertical reference points negatively influences the length errors. The smallest mean length error (i.e., smallest SD) of 0.65 (0.3) cm was found at location B, which was the location nearest to the vertical reference points. The largest mean error (i.e., largest SD) of 1.7 (0.33) cm, was found at location E.

For the angle test, although slight overestimations were observed around 100°–140°, overall agreement between the reconstructed and measured angles was obtained for each location (Figure 3). Similarly, in the length test, only the location had a significant effect on the errors between the calculated and measured angles ($F = 49.2$, $P <$

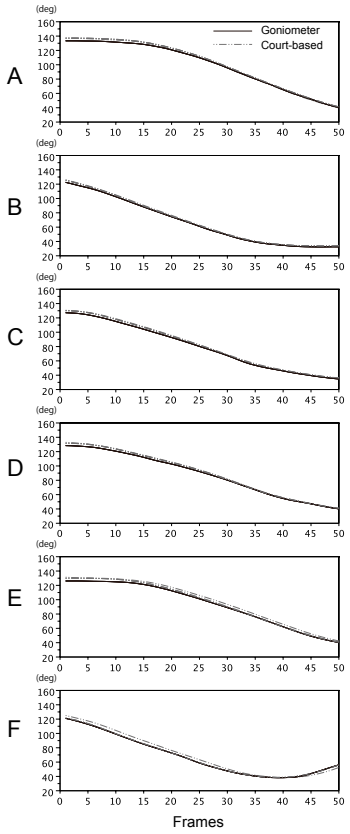
Table 1 Errors in length and angle trials [mean (SD)]

		Location					
		A	B	C	D	E	F
Length (cm)	Operator A	0.80 (0.23)	0.65 (0.30)	0.80 (0.27)	1.25 (0.21)^{A,B,C}	1.56 (0.29)^{A,B,C}	1.66 (0.43)^{A,B,C}
	Operator B	0.85 (0.25)	0.78 (0.26)	0.92 (0.27)	1.17 (0.23)^{A,B,C}	1.70 (0.33)^{A,B,C}	1.33 (0.48)^{A,B,C}
Angle (deg)	Operator A	2.22 (1.21)	1.67 (1.51)	2.49 (2.02)	3.67 (2.55)^{A,B,C,E}	1.92 (1.66)	3.76 (2.16)^{A,B,C,E}
	Operator B	1.92 (1.06)	1.91 (1.26)	2.52 (2.10)	3.70 (2.48)^{A,B,C,E}	1.68 (1.29)	3.90 (2.26)^{A,B,C,E}

Note: Super script denotes the location where the significant difference was found within the operator.
Since the main effect of processing session was not found, the values were averaged for each processing session.

Table 2 Errors in the reconstructed knee joint kinematics [mean (SD)]

		Flexion/Extension (deg)	Adduction/Abduction (deg)	Internal/External rotation (deg)
Operator A	First processing	3.09 (1.89)	3.13 (3.12)	6.15 (4.71)
	Second processing	2.71 (2.75)	3.45 (2.45)	6.53 (5.04)
Operator B	First processing	3.04 (2.54)	3.80 (3.57)	6.31 (4.46)
	Second processing	4.25 (2.42)	5.35 (3.08)	5.02 (3.60)



Figuer 3 The angle data comparison between the reconstructed from videos and measured with goniometer at each location

The solid line represents the goniometer data, and the gray dashed lines show the data from reconstructed the video image. Although some overestimations were observed around 100°-140°, the overall time patterns of the reconstructed angle data agreed well with the measured data.

0.01). The post-hoc test showed a slightly different result from the length test in that the errors at locations D (3.67°-3.70°) and F (3.76°-3.90°) were significantly greater than those at the other locations (Table 1), and the errors at location E (1.68°-1.92°) were not significantly different from those at locations A-C.

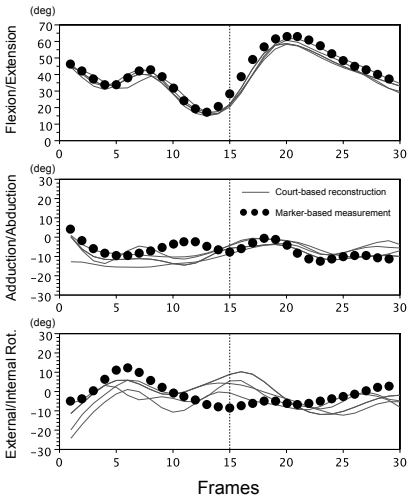


Figure 4 The knee kinematics comparison between the reconstructed with court-based technique and measured with the marker-based motion capture system

The dotted line represents the motion capture data, and the thin solid lines show the reconstructed data. The dashed vertical line at the 15th frame indicates the timing of the foot-floor contact. The knee flexion/extension was most accurately reconstructed. The reconstructed adduction/abduction data showed a slight deviation from the 9th to 15th frames, but agreed well with the measured data after foot contact. The external/internal rotation was the most inaccurate among these three angles.

B. Errors in knee joint kinematics

The general time patterns of the knee joint angles reconstructed using the court-based technique broadly matched those obtained with the marker-based technique (Figure 4). The flexion/extension (flex/ex) angle was most precisely reconstructed with a mean (SD) error ranging from 2.71° (2.75°) to 4.25° (2.42°) (Table 2). The adduction/abduction (add/abd) was moderately accurate with a mean (SD) error ranging from 3.13° (3.12°) to 5.35° (3.08°) (Table 2). Reconstruction of the internal/external (int/ext) rotation was the most inaccu-

rate with a mean (SD) error ranging from 5.02° (3.60°) to 6.53° (5.04°) (Table 2). Overall, the averaged differences between the results obtained using the court-based technique and the marker-based measurements were 3.27° for knee flex/ex, 3.93° for knee add/abd, and 6.00° for int/ext knee rotation (Table 2).

Ⅳ. Discussion

This study assessed the accuracy of court-based camera calibration technique for reconstructing human knee kinematics. Generally, reconstructed knee kinematics are influenced by two different errors, i.e., camera calibration errors and noise arising from the manual digitizing of body landmarks. We reasoned that these two errors should be evaluated separately. Thus, we first assessed the camera calibration accuracy alone using artificial objects, and then evaluated reconstructed knee kinematics that include potential error derived from human error.

A. Accuracy of the court-based camera calibration technique

Regarding our first objective, the errors for length with the court-based technique were <2 cm. This distance was only 0.1% of the handball court width (20 m). Furthermore, the maximum angle errors were <5°. Without using artificial reference objects, this precision level was achieved using the court geometric information alone. We reasoned that acquisition of precise image coordinates for reference points is quite important for accurate 3D reconstruction. To satisfy this issue, a custom-made LabVIEW script was developed to detect the positions of the reference points computationally. The small deviations between the reconstructed 3D reference point positions and the corresponding 3D coordinates demonstrated that the computational digitization worked well for acquiring precise reference point positions. The high color contrast between the court lines and floor was convenient for the automatic detection of reference points 14. Furthermore, the ANOVA test showed that no significant differences existed between operators and processing sessions in the length and angle tests. Hence, the accuracy of the court-based camera calibration technique was acceptable once the image coordinates for both the reference points and the objects were precisely determined. However, it is still difficult to conclude that the court-based calibration is sufficiently accurate for any type of motion analysis, because the requirements for precision vary for different research objectives. For example, studies requiring extremely high precision may not be possible because the accuracy level of the court-based technique is constrained by the video resolution. Notably, computational image processing is strongly recommended not only to increase calibration accuracy but also to maintain intra- and inter-operator consistency.

B. Influence of unevenly distributed vertical reference points

The limited number of the vertical reference points and poor camera orientations were found to be limitations in this technique. The errors in length measured at locations D–F were greater than those at locations A–C (Table 1), which clearly illustrates that length errors increase with increasing distance from the vertical reference points. In addition to the length errors, the angular errors also were increased at locations D and F. These increased errors were attributed to the poor relationship between the orientation of the link model and the cameras' optical axes such that the direction of joint rotation became nearly parallel to the optical axes of cameras 1 and 3 at locations D and F, and those camera views may not recognize the joint motion properly. This problem was expected because most studies have reported poor precision in reconstructing movement along the optical axis 12. Therefore, the reconstructed data near location E, which is the most active area during handball games, inevitably include errors derived from the limited number of vertical refer-

ence points.

Camera distance from the markers could be a potential source of the errors, however, few vertical reference points relatively much affected the reconstruction accuracy rather than the camera distance. If the close camera positioning could cancel the errors arising from the few vertical reference points, the length errors from the location D–F, the areas close to the cameras, were much smaller than those of the location A–C. It is thus not expected to decrease the errors by controlling the camera positions. To obtain the precise positional data far from the vertical reference points, another vertical information such as advertisement on the wall is a practical solution rather than the camera positioning.

C. Accuracy of knee joint kinematics and the corresponding objectivity and reliability

In addition to errors arising from the limited number of vertical reference points, numerical noise arising from the manual digitizing was expected to increase error in the reconstructed knee kinematics. To achieve the second research objective, we must address whether the errors in the reconstructed knee joint angles permit sufficient description of the knee joint motion usually observed in real injury situations. Krosshaug and Bahr 12 developed a video analysis technique named the model-based image matching (MBIM) technique. Their validation study showed that the potential errors of the MBIM technique were<7.5° for knee flex/ex, 4.9° for knee add/abd, and 9.1° for knee int/ext rotation using three camera views and not using any sports court reference points. Using this technique, Krosshaug et al. 20 analyzed video sequences of a female handball player's ACL injury at the right-back position (approximately location D in the present study) and reported that 15° peak knee abduction was observed 40 ms after the initial foot-floor contact. Koga et al. 13 also used the MBIM technique to investigate ACL injuries of female handball players and reported that 7°–15° knee abductions and 5°–21° peak external tibial rotations occurred at the knee at the time of injury. These studies successfully described the abnormally displaced knee kinematics because the potential errors of the MBIM technique were sufficiently small with respect to the joint angular displacement observed during ACL injuries. Compared to the precision of these previous techniques, the precision level determined for our court-based technique is sufficient for quantifying potentially abnormal joint kinematics during ACL injuries. Although the issue of too few vertical reference points was obvious, the precision of the court-based technique is still adequate for investigating the mechanism of ACL injuries.

In this study, the marker-based technique is used as a reference to evaluate the reconstruction accuracy in knee kinematics of the court-based technique. It is known that the marker-based technique also has potential limitation to detect precise knee kinematics. For example, the positional data from markers potentially contain oscillatory noises from skin artifacts. In addition, the markers on the skin do not always correspond to the bony movement. However, we must address what is the source of the angle difference between marker-based technique and court-based technique observed in this study. In flex/ex, both techniques showed similar trends through the landing trial. However, there were temporary inverse trends between techniques around 11 frames for add/abd and around 15 frames for ext/int. Obviously, these difference occurred because each technique used different position data to calculate joint angles, and it is not due to inaccuracy of the court-based technique itself. As mentioned in method section, the marker-based technique can computationally determined the center of hip joint by calculating from the position of the ASIS and great trochanter markers. On the other hand, the court-based technique needed to manually digitize the center of the hip joint from the 2D video data based on the anatomical knowledge. This technical difference pro-

duced differences in original positional coordinates and resulted in the errors of calculated knee joint angles. Figure 4 showed that the four angle data from the court-based technique showed similar trends, indicating that the positional coordinate from four individual digitizing processes had less deviation. This suggests that once the precise positional data were obtained, the precise angle reconstruction will be achieved by the court-based technique. Our length and angle trials also support the reconstruction accuracy of the court-based technique itself. Therefore the technical concern of the court-based technique is how to obtain precise positional data of the given body landmarks with manual digitizing.

While both operators showed small errors in reconstructing knee joint angles, OpB, who was the less experienced operator, scored a large error in the knee add/abd angle during her second data processing session (5.35°, Table 2). This human error could be another drawback of this technique when manual digitization is employed, the results may vary depending on operator's skill. For an individual with less knowledge of human anatomy, detecting the exact positions of joint centers with sufficient consistency is difficult. OpB proved the difficulty of the video processing in that detection of the hip joint center was especially difficult, potentially leading to the increased error in the knee add/abd angle during her second processing session. To eliminate such human error, a computational tracking algorithm could be introduced; however, describing the knee configuration in detail remains difficult. This may be due to the computational algorithm working under ideal conditions such as no occlusion of the targeted body parts, but the qualities of sports videos are not always favorable for such computer algorithms. In some cases, the orientation of an occluded limb or the positions of body landmarks of clothed players will need to be determined during the actual video editing procedure 8. In such cases, we believe that manual manipulation by experienced operators is the most robust and objective approach to ensure reconstructed motion quality. Although not included in this study, feedback-based data improvement [12] and the use of a kinematic constraint based on subjects' anthropometrics[25] can minimize human error and contribute to improved reconstruction accuracy.

In conclusion, the present study validated the accuracy of a court-based camera calibration technique aimed at reconstructing knee joint kinematics in the absence of a calibration object. Although increased errors were observed in areas far from the vertical reference points, the overall accuracy of the 3D reconstructions was reasonable. The reconstruction errors for the knee joint kinematics achieved by this technique were less than those of the previously reported video analysis technique, and the court-based camera calibration technique was found to sufficiently describe the abnormally displaced knee joint kinematics that occurs during ACL injury. At this time, even with the methodological concerns, such as errors arising from manual digitization, the court-based camera calibration technique can be used to quantify injurious knee motions from actual injury videos and provide beneficial insight for understanding the mechanism of ACL injury.

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【Review】

Characteristics and prevalence of eating disorders in aesthetic athletes

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Abstract

The prevalence of eating disorders in dancers was shown to be 12.0% in controls (16.4% for ballet dancers), 2.0% for those with anorexia (4% for ballet dancers), 4.4% for those with bulimia (2% for ballet dancers), and 9.5% for those with an eating disorder not-otherwise-specified (EDNOS) (14.9% for ballet dancers). New criteria for eating disorders were published in the 'Feeding and Eating Disorders' chapter of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) with modifications in 2013 by the American Psychiatric Association. Validation analyses demonstrated that the DSM-5 ED subgroups were well diagnosed to have variances in psychopathology as compared to the DSM-IV subgroups. In a study of aesthetic athletes, individual differences in the desire to be leaner to improve sports performance were associated with disordered eating. However, ballet dancers had a 3 times higher risk of suffering from eating disorders, particularly anorexia nervosa, and EDNOS, and appeared to be more similar to eating-disordered individuals than controls in measures of eating pathology. Ballet dancers are particularly prone to control their physiques, especially via restricted dietary practices, because of the aesthetic requirements of their genre, as well as the related issue of the pressure to manage every detail of their existence as a means to maintain their place in a dance company. Among 35 elite Brazilian professional female ballet dancers, 3 dancers (15.8%) had a lifetime diagnosis of anorexia nervosa and 2 others (10.5%) had a current diagnosis of body dysmorphic disorder (BDD). And moreover for elite gymnasts, as with other aesthetic athletes, weight and shape are areas of concern, thus the risk of eating disorders may be unusually high. Adolescent gymnasts, who are developing their own sense of self at a time of life when body image concerns are common, often compete at the very top of the sport with a need to maintain optimal body shape and weight for elite performance.

Preventive reports of methods available to reduce eating disorders in athletes have been increasing in recent years. Athletic trainers, coaches, and athletes are encouraged to increase their knowledge of eating disorders seen in athletes, and learn about risk factors, highest risk, and early identification strategies. Finally, when an athlete with anorexia nervosa, bulimia nervosa, or another type of eating disorder does not respond to sound advice, introduction to a psychiatrist specialized in treating eating disorders is important. Early detection and treatment of disordered eating should be a high priority for athletics programs.

Ⅰ. Introduction

All athletes hope to show their best performance when participating in their chosen sport. Unfortunately, some develop eating disorders, among which anorexia nervosa and bulimia nervosa are serious problems, especially in dancers and gymnasts. In the general population, Eating disorders (EDs) have a prevalence in about 0.6% individuals with anorexia nervosa, 1% in those with bulimia nervosa, and 3% in those with binge eating disorder,[1-3] while the present lifetime prevalence of all

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EDs is about 5%.[2] In a recent study of women that utilized the lifetime prevalence criteria of the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5), anorexia nervosa was noted in 1.7%, bulimia nervosa in 0.8%, and binge eating disorder in 2.3%.[4] Eating disorder not-otherwise-specified (EDNOS) before publishing of the DSM-5 ranged from 40% to 70% of patients with an eating disorder seeking treatment.[5, 6] EDs are particularly common in adolescents and young adults, and also seem to be more prevalent among athletes as compared to non-athletes. Indeed, in a large and well designed study of top athletes, EDs were found in 13.5%, far higher than reported for the general population.[7]

In a review of the prevalence of EDs in dancers, those were seen in 12.0% of controls (16.4% for ballet dancers), 2.0% of those with anorexia (4% for ballet dancers), 4.4% of those with bulimia (2% for ballet dancers), and 9.5% of those with EDNOS (14.9% for ballet dancers).[8] Furthermore, the ballet dancer group had a higher mean score for the Eating Attitudes Test-26 (EAT-26)[9] and Eating Disorder Inventory subscales.8 In general, dancers in that study had a higher risk of suffering from eating disorders, anorexia nervosa, and EDNOS, but not bulimia nervosa. The authors concluded that since ballet dancers had a 3 times higher risk of suffering from eating disorders, particularly anorexia nervosa and EDNOS, specifically designed services for that population should be considered.[8] However, a more recent paper showed that the definition shift between DSM IV and DSM-5 changes the risk of developing anorexia nervosa to double in dancers.[10] In another study, 83% of dancers met the lifetime criteria for anorexia nervosa (6.9%), bulimia nervosa (10.3%), anorexia nervosa + bulimia nervosa (10.3%, coincidentally the same as for bulimia nervosa), or EDNOS (55.0%). Moreover, dancers appeared to be more similar to eating-disordered than control individuals in measures of eating pathology.[11] In this paper, we introduce recent papers in characteristics, prevalence and noticeable points of aesthetic athletes mainly in ballet dancers.

Ⅱ. Psychiatric diagnosis of feeding and eating disorders (DSM-IV, DSM-IV-TR, DSM-5)

There are major changes DSM-5 as compared to DSM-IV, which have led to an increased prevalence of anorexia and bulimia nervosa, and decreased prevalence of EDNOS. According to DSM-5, binge-eating disorder (BED) has a distinct category of its own.[12] Another study that compared DSM-IV and DSM-5 showed that the prevalence of full-threshold eating disorders increased from 1.8% (DSM-IV) to 3.7% (DSM-5), with a higher prevalence of bulimia nervosa (1.6%) along with the addition of the diagnosis of purging disorder (1.4%), while the prevalence of binge eating disorder was unchanged (0.5%) and non-specified cases decreased from 5.1% (DSM-IV) to 3.4% (DSM-5). Validation analyses demonstrated that the DSM-5 ED subgroups had a more well-diagnosed variance in psychopathology than the DSM-IV subgroups.[13]

New criteria for eating disorders are presented in the "Feeding and Eating Disorders" chapter of DSM-5 with modifications in 2013 by the American Psychiatric Association (APA).[14] Those modifications include addition of 3 disorders (avoidant/restrictive food intake disorder, rumination disorder, pica) previously described in the DSM-IV-TR section title "Feeding and Eating Disorders of Infancy or Early Childhood," along with clarifications and modifications to anorexia nervosa and bulimia nervosa, and inclusion of binge eating disorder as a formal diagnosis.[15] Anorexia nervosa is defined by persistent restriction of energy intake leading to significantly low body weight, intense fear of gaining weight, or persistent behavior that interferes with weight gain and disturbance in the way one's body weight or shape is experienced. The requirement for amenorrhea has been eliminated in DSM-5.[15] Pica is defined as the repeated ingestion of nonnutritive substances (pebbles, hair, small metal objects, etc.). This disorder is common in children

and more rarely in adults with developmental disorders (e.g., autism) or mental retardation.[16] Though pica and rumination disorder have been studied in select populations (e.g., pregnant women, intellectually disabled individuals), their typical features and overall prevalence remain generally unknown.

Application of the DSM-5 criteria effectively reduces the frequency of the residual diagnosis EDNOS, by lowering the threshold for anorexia nervosa and bulimia nervosa, and adding binge eating disorder as a specified eating disorder.[17, 18] In another study, the most common DSM-5 eating disorder diagnoses in adolescents in the community were anorexia nervosa and binge eating disorder. Severity ratings for EDs seem valid in terms of both distribution in the community, and the correlation with detection and treatment by health care services. In contrast, the "Feeding and Eating Disorders" chapter of DSM-5 may be not well constructed, thus some critical papers have been presented. For example, it is argued that there are a number of problems in the checklist approach to diagnosis, including no points of rarity between common disorders, and that many disorders are rough groupings containing highly heterogeneous syndromes. The tendency to rectify these disorders and view them as independent entities, and to stretch the concept of co-morbidity to cover individuals who satisfy more than one of the diagnostic checklists is seen as being misleading, as it gives a false air of precision.[19] DSM-IV was published in 1994 by APA, while DSM-IV-TR (Table 1-B) was published in 2000 and DSM-5 in 2013. Thus, there are some differences such as prevalence or percentage of patients, depending on use of criteria from one of those.[13, 15, 17-19] Diagnostic criteria for anorexia nervosa, bulimia nervosa, EDNOS, and binge eating are presented in Table. 1-A (DSM-IV) and Table. 1-B (DSM-IV-TR), while surprising changes from DSM-IV to DSM-5 are shown in Table 2. Furthermore, a schematic presentation of EDNOS is shown in Figure 1.[6] Subtyping of bulimia nervosa has been removed, while there are very few changes in the criteria for pica and rumination disorder. In addition, 2 new official feeding and eating disorders have been introduced in DSM-5, avoidant/restrictive food intake disorder and binge eating disorder (Table. 2).[20]

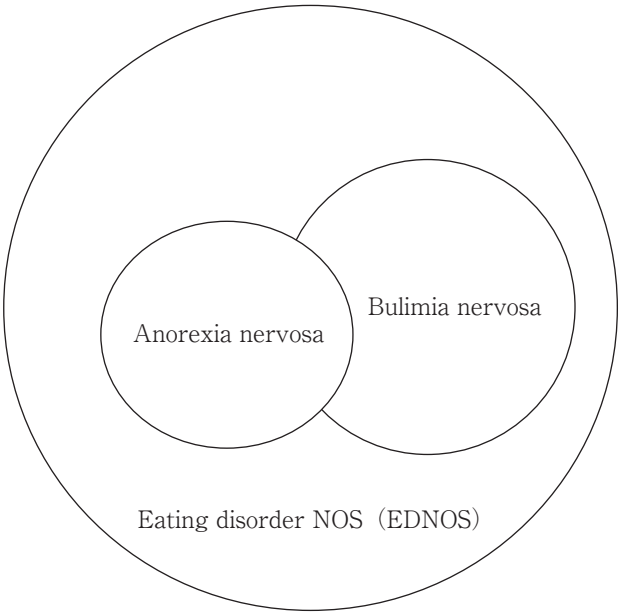

Figure 1. Eating disorder "case"

Table. 1-A. DSM-IV Diagnostic Criteria for Eating Disorders

Anorexia Nervosa A. Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected).
B. Intense fear of gaining weight or becoming fat, even though underweight.
C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight.
D. In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g., estrogen, administration.)
Specify type: **Restricting Type:** during the current episode of Anorexia Nervosa, the person has not regularly engaged in binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)
Binge-Eating/Purging Type: during the current episode of Anorexia Nervosa, the person has regularly engaged in binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)
Bulimia Nervosa A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:
(1) eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances (2) a sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)
B. Recurrent inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise.
C. The binge eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for 3 months.
D. Self-evaluation is unduly influenced by body shape and weight.
E. The disturbance does not occur exclusively during episodes of Anorexia Nervosa.
Specify type: **Purging Type:** during the current episode of Bulimia Nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas
Nonpurging Type: during the current episode of Bulimia Nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas
Eating Disorder Not Otherwise Specified The Eating Disorder Not Otherwise Specified category is for disorders of eating that do not meet the criteria for any specific Eating Disorder. Examples include
1. For females, all of the criteria for Anorexia Nervosa are met except that the individual has regular menses.
2. All of the criteria for Anorexia Nervosa are met except that, despite significant weight loss, the individual's current weight is in the normal range.
3. All of the criteria for Bulimia Nervosa are met except that the binge eating and inappropriate compensatory mechanisms occur at a frequency of less than twice a week or for a duration of less than 3 months.
4. The regular use of inappropriate compensatory behavior by an individual of normal body weight after eating small amounts of food (e.g., self-induced vomiting after the consumption of two cookies).
5. Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
6. Binge-eating disorder: recurrent episodes of binge eating in the absence of the regular use of inappropriate compensatory behaviors characteristic of Bulimia Nervosa (see Appendix B in DSM-IV-TR for suggested research criteria).
In the DSM-IV-TR, **Binge Eating Disorder** was listed in the Appendix B as "Criteria Sets and Axes for Further Study." In relation to this then "proposed disorder", the following was observed: ("The essential features are recurrent episodes of binge eating associated with subjective and behavioral indicators of impaired control over, and significant distress about, the binge eating and the absence of the regular use of inappropriate compensatory behaviors (such as self-induced vomiting, misuse of laxatives and other medications, fasting, and excessive exercise) that are characteristic of Bulimia Nervosa…") (Reference: American Psychiatric Association. (1994). Diagnostic and Statistical Manual of Mental Disorders (4th Ed.) United States of America: American Psychiatric Association.)

Table. 1-B Eating Disorder Diagnostic Criteria from DSM IV-TR

Anorexia Nervosa: Refusal to maintain body weight at or above a minimally normal weight for age and height, for example, weight loss leading to maintenance of body weight less than 85% of that expected or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected.
Intense fear of gaining weight or becoming fat, even though underweight. Disturbance in the way one's body weight or shape is experienced, undue influence of body weight or shape on self evaluation, or denial of the seriousness of the current low body weight. In postmenarcheal females, amenorrhea, i.e., the absence of at least 3 consecutive menstrual cycles. A woman having periods only while on hormone medication (e.g. estrogen) still qualifies as having amenorrhea.
Type: Restricting Type: During the current episode of Anorexia Nervosa, the person has not regularly engaged in binge-eating or purging behavior (self-induced vomiting or misuse of laxatives, diuretics, or enemas).
Binge Eating/Purging Type: During the current episode of Anorexia Nervosa, the person has regularly engaged in binge-eating or purging behavior.
Bulimia Nervosa
Recurrent episodes of binge eating characterized by both
1. Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances.
2. A sense of lack of control over eating during the episode, (such as a feeling that one cannot stop eating or control what or how much one is eating).
Recurrent inappropriate compensatory behavior to prevent weight gain, such as selfinduced vomiting, misuse of laxatives, diuretics, enemas, or other medications, fasting, or excessive exercise.
The binge eating and inappropriate compensatory behavior both occur, on average, at least twice a week for 3 months.
Self evaluation is unduly influenced by body shape and weight.
The disturbance does not occur exclusively during episodes of Anorexia Nervosa.
Type: Purging Type: During the current episode of Bulimia Nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas.
Nonpurging Type: During the current episode of Bulimia Nervosa, the person has used other inappropriate compensatory behavior but has not regularly engaged in selfinduced vomiting or misused laxatives, diuretics, or enemas.
Eating Disorder Not Otherwise Specified
This diagnosis includes disorders of eating that do not meet the criteria for the above two eating disorder diagnoses. Examples include
1. For female patients, all of the criteria for Anorexia Nervosa are met except that the patient has regular menses.
2. All of the criteria for Anorexia Nervosa are met except that, despite significant weight loss, the patient's current weight is in the normal range.
3. All of the criteria for Bulimia Nervosa are met except that the binge eating and inappropriate compensatory mechanisms occur less than twice a week or for less than 3 months.
4. The patient has normal body weight and regularly uses inappropriate compensatory behavior after eating small amounts of food (e.g., self-induced vomiting after consuming two cookies).
5. The patient engages in repeatedly chewing and spitting out, but not swallowing, large amounts of food.
6. Binge-eating disorder: recurrent episodes of binge eating in the absence if regular inappropriate compensatory behavior characteristic of Bulimia Nervosa.
(Adapted from American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, 4th ed, text rev. Washington, DC, American Psychiatric Association, 2000.)
Listed in the DSM IV-TR appendix as a diagnosis for further study, Binge Eating Disorder is defined as uncontrolled binge eating without emesis or laxative abuse. It is often, but not always, associated with obesity symptoms. Night eating syndrome includes morning anorexia, increased appetite in the evening, and insomnia. These patients can have complete or partial amnesia for eating during the night. (Reference: American Psychiatric Association. (1994). Diagnostic and Statistical Manual of Mental Disorders (4th Ed.) United States of America: American Psychiatric Association.)

Table. 2 DSM-5

Anorexia Nervosa: According to the DSM-5 criteria, to be diagnosed as having Anorexia Nervosa a person must display: Persistent restriction of energy intake leading to significantly low body weight (in context of what is minimally expected for age, sex, developmental trajectory, and physical health). Either an intense fear of gaining weight or of becoming fat, or persistent behaviour that interferes with weight gain (even though significantly low weight). Disturbance in the way one's body weight or shape is experienced, undue influence of body shape and weight on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight.
Subtypes: Restricting type Binge-eating/purging type
Bulimia Nervosa: According to the DSM-5 criteria, to be diagnosed as having Bulimia Nervosa a person must display: Recurrent episodes of binge eating. An episode of binge eating is characterised by both of the following: Eating, in a discrete period of time (e.g. within any 2-hour period) , an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances. A sense of lack of control over eating during the episode (e.g. a feeling that one cannot stop eating or control what or how much one is eating). Recurrent inappropriate compensatory behaviour in order to prevent weight gain, such as self-induced vomiting, misuse of laxatives, diuretics, or other medications, fasting, or excessive exercise. The binge eating and inappropriate compensatory behaviours both occur, on average, at least once a week for three months. Self-evaluation is unduly influenced by body shape and weight. The disturbance does not occur exclusively during episodes of Anorexia Nervosa.
Binge Eating Disorder: According to the DSM-5 criteria, to be diagnosed as having Binge Eating Disorder a person must display:
Recurrent episodes of binge eating. An episode of binge eating is characterised by both of the following: Eating, in a discrete period of time (e.g. within any 2-hour period) , an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances. A sense of lack of control over eating during the episode (e.g. a feeling that one cannot stop eating or control what or how much one is eating).
The binge eating episodes are associated with three or more of the following: eating much more rapidly than normal, eating until feeling uncomfortably full, eating large amounts of food when not feeling physically hungry, eating alone because of feeling embarrassed by how much one is eating, feeling disgusted with oneself, depressed or very guilty afterward
Marked distress regarding binge eating is present
Binge eating occurs, on average, at least once a week for three months
Binge eating not associated with the recurrent use of inappropriate compensatory behaviours as in Bulimia Nervosa and does not occur exclusively during the course of Bulimia Nervosa, or Anorexia Nervosa methods to compensate for overeating, such as self-induced vomiting.
Note: Binge Eating Disorder is less common but much more severe than overeating. Binge Eating Disorder is associated with more subjective distress regarding the eating behaviour, and commonly other co-occurring psychological problems.
Pica: According to the DSM-5 criteria, to be diagnosed with Pica a person must display: Persistent eating of non-nutritive substances for a period of at least one month…
Rumination Disorder:…
Avoidant/Restrictive Food Intake Disorder (ARFID) : …
Other Specified Feeding or Eating Disorder (OSFED) …
Atypical Anorexia Nervosa::…
Binge Eating Disorder (of low frequency and/or limited duration) : ….
Bulimia Nervosa (of low frequency and/or limited duration) :….
Purging Disorder: …
Night Eating Syndrome: Recurrent episodes of night eating….,The behavior causes significant distress/impairment. The behavior is not better explained by another mental health disorder (e.g. BED).
Unspecified Feeding or Eating Disorder (UFED) ….
(American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders, 5th Edn. Washington, DC: APA.)

Ⅲ. Prevalence and characteristics of Eating disorders in aesthetic sports

A 1-year longitudinal investigation was developed with 2 assessment points to identify risk factors for disordered eating in aesthetic sports, including gymnastics, figure skating, diving, and ballet.[21] Sixty-five adolescent elite athletes (mean age 14.0±2.2 years: 38 girls, 27 boys) participated. To identify disordered eating, a self-report questionnaire was applied. The study focused on sports-related variables as potential risk factors. It is important to note that the authors claimed to be unaware of any other studies that had prospectively examined sports-related social pressure. This study found that individual changes in desire to be leaner to improve sports performance were associated with disordered eating. A cross-lagged partial correlation analysis also showed that the desire to be leaner to improve sports performance was predictive of disordered eating and not vice versa. For aesthetic sports, the prevalence of disordered eating was estimated to be approximately 40%, while that was approximately 30% in weight-class sports for elite female athletes.[22] In contrast, the rate of prevalence for team sports was 15% in elite female athletes,[23] while that in the general population ranges from 0% to 21%.[1-4, 24]

Optimization of body weight and composition may be a key priority for elite athletes striving for a competitive advantage. A study of 223 Swedish athletes participating in the Olympic Games of 2002 and 2004 compared those participating in disciplines that emphasize leanness with those participating in non-leanness sports. The results showed that the lean athletes had a lower mean body mass index, greater variation in weight during the year prior to the competition, more frequent attempts to lose weight, longer total training time, and higher training load, yet weighed more than they desired during the competition. Beyond that, 9.4% reported previously suffering from an ED as compared to 2.7% of the non-lean athletes. Therefore, weight control practices employed by Olympic athletes participating in disciplines that emphasize leanness appear to be suboptimal. Counseling concerning weight control could be used as a tool to prevent illness and enhance performance.[25]

Female athletes are often very body conscious with respect to their weight and appearance, and evidence has been presented showing that a positive body image is often associated with physical activity.[26] However, results of a study of 1445 elite Division I athletes suggest that gender, ethnicity, sport, and self-esteem are associated with several behaviors and attitudes indicative of disordered eating in elite athletes[27] The EAT-26 test[9] was used to study female adolescent Brazilian tennis players (n=24) and sedentary female adolescents as controls (n=21), which showed that the controls had more body image distortion or dissatisfaction as compared to the athletes. The authors speculated that athletes can adopt disordered eating practices while maintaining a realistic sense of themselves as being leaner than, or more fit than, their non-athlete counterparts. They also noted that tennis players appeared to have more severe disorders than the controls, and recommended that they be monitored to avoid damage to their performance and health.[28] It is speculated that some female tennis players feel that tennis is a partially aesthetic sport, based on media representations.

It was previously reported that ballet dancers had a 3 times greater risk of suffering from EDs, particularly anorexia nervosa and EDNOS,[8] and seemed to be more similar to eating-disordered subjects than to control subjects in measures of eating pathology.[11] Disordered eating and EDs are well known to have a relationship to injuries in dancers.[29-32] In addition, physiques generally associated with female ballet dancers, i.e., high ectomorphy, low mesomorphy, and low percent body fat, have been linked to increased injury risk.[33] Ballet dancers are particularly prone to control their physiques, especially by restricted dietary practices, because of the aesthetic requirements of their genre, as well as the related issue of pressure to

manage every detail of their existence as a means to maintain their position in a dance company.[34]

Among 35 elite Brazilian professional female ballet dancers, 3 (15.8%) had a lifetime diagnosis of anorexia nervosa and 2 others (10.5%) had a current diagnosis of body dysmorphic disorder (BDD).[32] Anorexia nervosa and BDD are severe body image disorders that impair individuals in regard to daily functioning. Although discrete, they are overlapping nosological entities.[35] In this confusing understanding between anorexia nervosa and BDD, it is argued that EDs and psychotic disorders are different expressions of the same illness, with distorted thoughts about eating being a form of delusion.[36] Interestingly, auditory hallucinations, the hallmark of psychotic conditions, also occur in anorexia nervosa.[37-41] In addition, depersonalization and derealization are common symptoms of both disorders,[42] as are overvalued ideas.[35, 43] Anorexia nervosa and BDD are characterized by distorted body image and frequently show co-morbidity, though their relationship remains largely unknown. Those were investigated using 2 complementary modalities, event-related potentials (ERPs) and functional magnetic resonance imaging (f MRI), to test for abnormal activity associated with early visual signaling. fMRI and ERP data were acquired in separate sessions from 15 non-medicated individuals in each of 3 groups (weight-restored anorexia nervosa, BDD, healthy controls) while each subject viewed images of faces and houses at different spatial frequencies. Joint independent component analyses were used to compare activity in visual systems. The anorexia nervosa and BDD groups demonstrated a similar level of hypoactivity in the early secondary visual processing regions and dorsal visual stream when viewing low spatial frequency faces, which are linked to the N170 component (the vertex positive potential, VPP, see Jeffreys, 1989), as well as in early secondary visual processing regions when viewing low spatial frequency houses, linked to the P100 (the major positive) component. Additionally, the BDD group exhibited hyperactivity in the fusiform cortex when viewing high spatial frequency houses, linked to the N170 component. Greater activity in this component was associated with lower attractiveness ratings of faces. It was concluded that those findings provided preliminary evidence of similar abnormal spatiotemporal activation in anorexia nervosa and BDD for configural/holistic information for appearance- and non-appearance-related stimuli. In addition, a common phenotype of abnormal early visual system functioning was suggested, which may contribute to perceptual distortions.[44]

For elite gymnasts, as with other aesthetic athletes, weight and shape are areas of concern, thus the risk of EDs may be unusually high. Adolescent gymnasts, who are developing their own sense of self at a time of life when body image concerns are common, often compete at the very top of the sport with a need to maintain optimal body shape and weight for elite performance.[45] Thus, the athletes and their coaches make efforts to not develop EDs. Parents, teachers, and coaches generally have a strong influence on young athletes, thus their coordinated efforts play important roles in the development or prevention of disordered eating.[46] Aesthetic sports, especially when performed on a competitive level, are often considered as risk factors for development of EDs. In a previous study, 50 elite rhythmic gymnasts (mean age 14.8 years) including the German national team, 58 female patients with anorexia nervosa (mean age 15.5 years), and 56 high school girls (mean age 14.9 years) completed the Eating Disorder Inventory-2 and the Test for Detecting Body Image Distortion in Children and Adolescents (test of body image interference for children and adolescents), while body weight and height, body mass index, presence of amenorrhea, and frequency of exercise were surveyed. Even though some physical similarities were found between the elite rhythmic gymnasts and anorexia nervosa patients, contrary to previous studies, there were no noticeable prob-

lems related to attitudinal aspects of EDs detected in the elite rhythmic gymnasts. A mildly distorted body image of the abdomen was identified in those elite rhythmic gymnasts, while the anorexia nervosa patients expressed broad body image distortion and the students expressed no body image distortion. However, those data were not sufficient to draw conclusions regarding prevalence rates, long-term effects, or male athletes.[47] Another study of 138 equestrian athletes (mean age 19.9±1.3 years; English riding 91, Western riding 47) used the EAT-26 and concluded that disordered eating risk prevalence among them was similar to that reported in other aesthetic sports and lower than in non-aesthetic sports. Athletic trainers working with such athletes should be sensitive to these risks and refer each athlete as needed to clinicians knowledgeable about disordered eating. Professionals working with this population should also avoid making negative comments about physical size and appearance.[48] Reports of prevention and decreased EDs in athletes have been increasing in recent years.

Ⅳ. Prevention of EDs in athletes

It is recommended that prevention of EDs be a mandatory part of educational curricula for coaches and athletes across all sports. An excellent strategy to initiate eating disorder prevention in female athletes is simply to increase knowledge among them and related health professionals about correlates, risk factors, highest risk, and early identification strategies.[22] Notably, athletic trainers and those who participate in athletic health care should be familiar with the current National Athletic Trainers' Association (NATA) position statement that outlines prevention, detection, and management of disordered eating in athletes.[49] However, it remains to be addressed what should be done athletes at the greatest risk are identified.

Inadequate food intake appears to be the first symptom of an ED, followed by use of inappropriate methods for weight loss, and excessive increases in exercise time and load. As compared with disordered eating-negative athletes, positive athletes had a higher percentage of body fat and fat mass, lower protein consumption in the 11- to 14-year-old group, and lower calcium intake adequacy in the 15- to 19-year-old group. It was concluded that greater attention should be given to the nutritional state of these athletes, especially after considering the number of adolescents with anemia and inadequate dietary intake.[50] Early detection is important and can lead to early prevention. The Eating Attitudes Test EAT-26[9] and Eating Disorders Inventory[51] are questionnaires most often used in studies included in a well-known review article.[24] Both questionnaires represent the most commonly used measures to screen for psychological and behavioral symptoms of anorexia nervosa and bulimia nervosa. Additionally, the Eating Disorder Examination Questionnaire is a valid and reliable questionnaire, as it is a self-reported version of the Eating Disorder Examination Interview (EDE),[52] the gold standard for diagnosis of EDs. By using these 2 questionnaires and clinical interviews, certified athletic trainers and physical coaches can become more skilled observers of the behavior of athletes, which may provide the quickest means of detecting disordered eating. In a recent study, eating pathology and BMI were positively associated with anti-dieting advice received from teammates.[53] Therefore, education is an important step, not only for health professionals but also athletes, to enhance prevention of EDs.[22, 49]

It is considered that early detection and treatment of disordered eating should become a high priority for athletics programs. Disordered eating occurs along a continuum of severity. Mild symptoms that increase in frequency and severity may progress to 3 clinically diagnosable conditions identified in the DSM-5 (original expression: DSM-IV as anorexia nervosa, bulimia nervosa, and EDNOS).[49] If the athlete is classified as anorexia nervosa, bulimia nervosa, or EDNOS, the detecting individual should introduce them to a psychiatrist

specialized in EDs.

Ⅴ. Psychological effects of exercise and problems in athletes

Results of 14 selected studies regarding the effectiveness of exercise as intervention in management of depression in the general population, the effect of exercise for reducing symptoms of depression could not be determined because of a lack of good quality research on clinical populations with adequate follow-up examinations.[54] However, a meta-analysis of randomized trials showed that exercise in individuals with anxiety and sedentary patients with comorbid chronic illnesses was associated with improvements in anxiety symptoms.[55] Another study of patients with anxiety disorders, including panic attacks, social phobia, and generalized anxiety, found that exercise improved anxious symptoms, but not to the same extent as improvements seen with pharmacological treatment.[56] In a study of 20 patients with schizophrenia, 13 patients with depression, and 20 healthy controls, high aerobic intensity training used as acute intervention improved positive attitude and sense of well-being, and also reduced distress and state anxiety in patients with depression and schizophrenia.[57] Also, effective training to improve peak VO_2 provided acute psychological benefits. Reductions in distress and state anxiety were sustained for more than 3 hours after high aerobic intensity training, and patients with depression also sustained an improved positive affect and sense of well-being. The duration of the improved positive affect was longer for those with depressive and schizophrenia disorders than for healthy individuals. Another study revealed that aerobic exercise was associated with modest improvements in attention/processing speed, executive function, and memory. In addition, trials that used individuals with mild cognitive impairment demonstrated greater improvement in memory performance relative to healthier samples, suggesting that the beneficial effects of exercise on various cognitive functions may be most evident in participants with pre-existing cognitive impairment.[58]

Although epidemiological studies on the psychological health of high level athletes are few, results of an investigation that focused on the psychological health of high level athletes in female and men were published in 2011. In that study, the occurrence of lifetime generalized anxiety disorder (GAD) according to type of sport is presented (Figure 2), with significantly higher rates of GAD found for aesthetic sports (38.9% vs. 10.3% for women in all other sports, 16.7% vs. 6.8% for men in all other sports). The gender difference in the prevalence of GAD remained significant when only aesthetic sports were examined, while high risk sports had the lowest prevalence of GAD for both women and men (3.5% and 3.0%, respectively). The prevalence of depression problems according to type of sport followed the trend observed with GAD (Figure 3). The lifetime occurrence of at least 1 period of depression was highest in aesthetic sports (24.2%), followed by aiming and fine motor skills sports (18.2%). Furthermore, the rate of depression was significantly lower in team ball sports (8.1%) and high risk sports showed the lowest prevalence of depression at 7.4%, though significance was not reported due to the low number of athletes studied.[59] In a French adult population (n=36,105), the overall prevalence of anxiety disorders was estimated to be 21.6%, with generalized anxiety disorder the most prevalent (12.8%). Women, young individuals, and individuals earning a low income were identified as more at risk. A major depressive episode, alcohol abuse, and drug addiction frequently co-occur with anxiety disorders (28.3%, 4.4%, and 2.8% respectively).60 Sleep problems were also more prevalent in aesthetic sports (33.3%), while athletes in high risk sports had significantly less sleep issues than the others.[59]

The lifetime occurrence of any ED showed different sport-specific trends in men and women, with the highest rates of EDs found in women involved in racing sports and fine motor skills sports, while those playing team ball sports had the low-

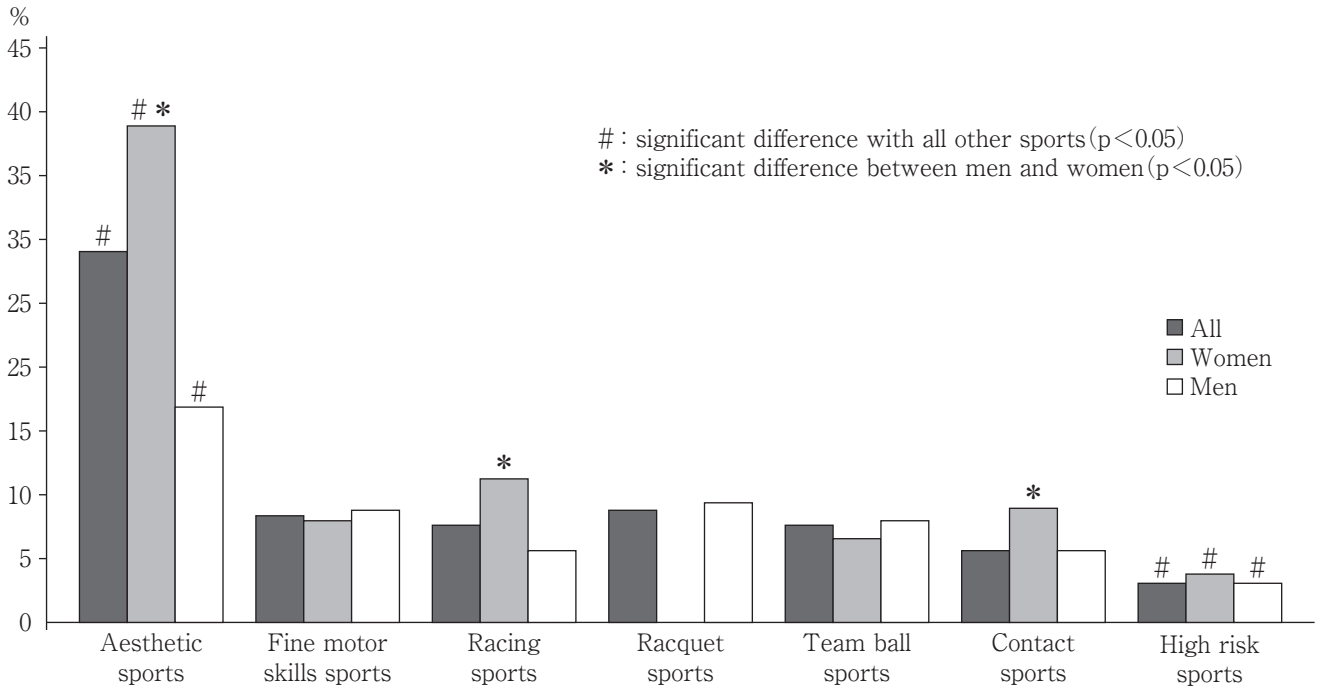

Figure 2. Lifetime prevalence of generalized anxiety by type of sport played.

Schaal K, Tafflet M, Nassif H, Thibault V, Pichard C, et al. (2011) Psychological Balance in High Level Athletes: Gender-Based Differences and Sport-Specific Patterns. PLoS ONE 2011 May 4;6(5):e19007. doi: 10.1371/journal.pone.0019007.

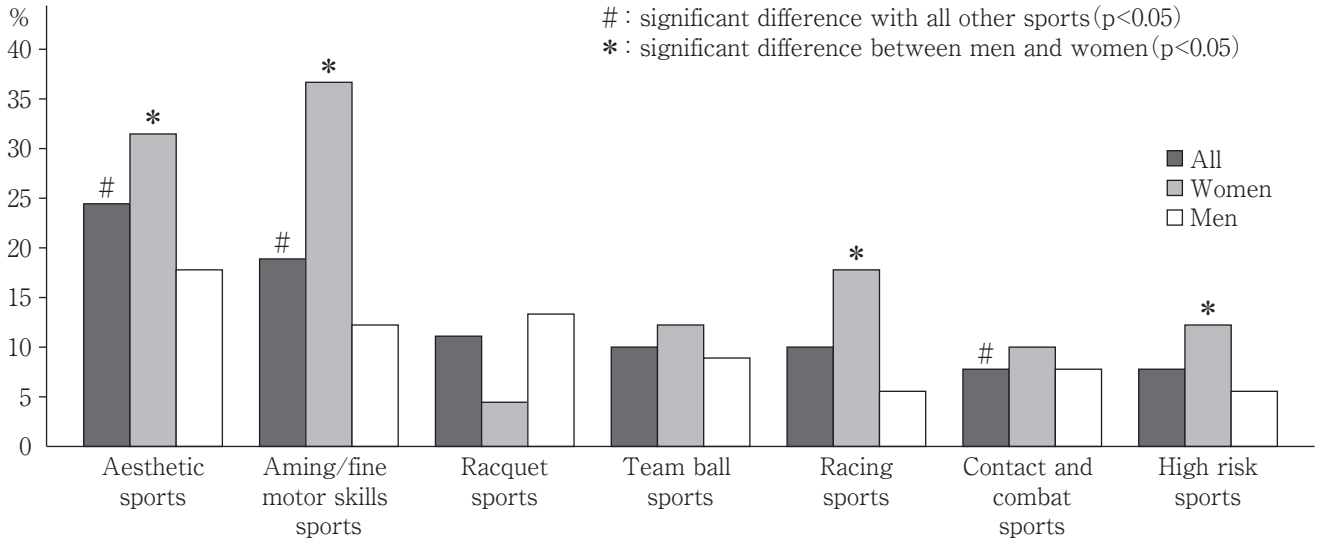

Figure 3. Lifetime prevalence of minor or major depression according to the type of sport practiced.

Schaal K, Tafflet M, Nassif H, Thibault V, Pichard C, et al. (2011) Psychological Balance in High Level Athletes: Gender-Based Differences and Sport-Specific Patterns. PLoS ONE 2011 May 4;6(5):e19007. doi: 10.1371/journal.pone.0019007.

est occurrence of such problems (14%, 14%, and 5.8% respectively).[59] For male athletes, participation in combat and contact sports showed the highest prevalence of EDs (7.3%). In the general population over 18 years old, the lifetime estimated prevalence rates of anorexia nervosa, bulimia nervosa, binge eating disorder, sub-threshold binge eating disorder, and any binge eating were 0.48%, 0.51%, 1.12%, 0.72%, and 2.15%, respectively, and those were 3-8 times higher in women for all EDs.[61]

Longitudinal human studies can now identify el-

evated trait anxiety, and genetic, behavioral, or physiological parameters, such as anxiety sensitivity[62] or baseline pro-inflammatory state[63] as early markers of inherent vulnerability.[64] Unfortunately, no comprehensive studies have been conducted on the interaction of biological sex and gender identity regarding anxiety disorders in transgender men and women.[65, 66] Anxiety-relevant research on sex differences within central autonomic control of the sympathetic and parasympathetic pathways are also chronically under-researched and deserve more attention.[67, 68]

The prevalence of EDs is higher in athletes than the general population.[7] The practice of a sport at a high level does not appear to be a psycho-pathogenic behavior, since the prevalence of psychopathology identified in athletes is no higher than that in the general population. Rather, it is the presence of very particular stressors, such as problems in the athletes' social, personal, and sporting environments that is associated with psychopathology. Psychological issues and the stressors from which they stem should be addressed early, in order to help avoid the development of a full-blown disorder and its potential consequences on the health and career of the affected athlete. The presence of sex bias in regard to anxiety and affective disorders provides reason enough to acknowledge, instead of ignore, the complexity introduced by the female menstrual cycle and intensify research on sexually dimorphic developmental programming of the brain as well as sex-dependent stress coping mechanisms in adulthood.[64] It was reported that participation in a high-performance sport was not an additional source of distress for adolescents who reported high stress levels, despite prior research that has pointed toward such a relationship.[69] Additional studies are needed to for athletes to provide their best performance with a healthy mind and body. When a coach, trainer, or individual working with athletes is highly suspicious of anorexia nervosa, bulimia nervosa, or any other ED that cannot be coped with, it is important to consult with a psychiatrist specialized in treating such conditions.

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第４回　健康運動科学研究所シンポジウム　臨床講演

当院における慢性期脳卒中片麻痺患者への臨床応用

～ロボットスーツ　HALを用いて～

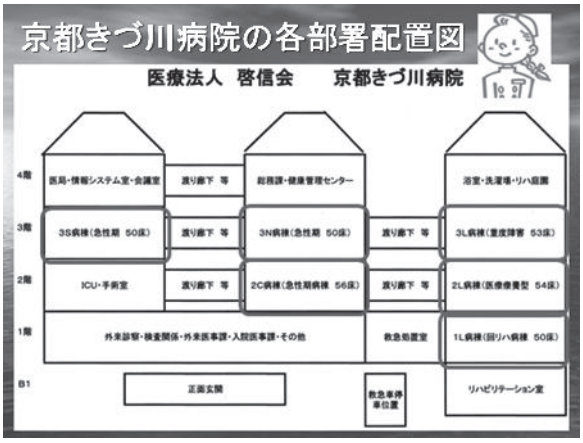
講師　　京都きづ川病院　リハビリテーション室　室長　中本 隆幸 先生

はじめまして。京都から参りました、きづ川病院の中本と申します。

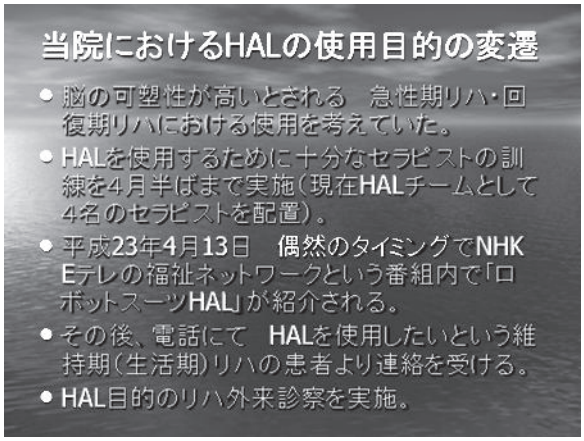
今回は「当院における慢性期脳卒中片麻痺患者さんへの臨床応用」というテーマをいただいております。言い換えますと、まだ当院では脳卒中しかしていないという状態です。では、話を進めて参ります。

まず、ロボットスーツですが、ダイワハウス様がデモンストレーションに来られましが、当初は一旦見送りになりました。一番の理由は金額的な問題です。私自身は入れさせてもらいたかったので、その後、理事長、院長と事務長と話をさせていただき、何とかご理解いただきまして、平成23年の３月に２回目のデモンストレーションに来ていただきました。この時には、ロボットスーツHALはバージョンアップしていまして、以前のものよりは良いものになっていました。導入目的でデモンストレーションしていましたので、そのまま導入となり、３年半が経過いたしました。今回は主に２症例を紹介させていただきます。

簡単に当院のご紹介をさせていただきます。京都きづ川病院は313床の一般病院で、スライドに示すような外観です。建物的には、こちらで示していますように、３棟から成っています。この３つの約150床が急性期病棟になっていまして、こちらの３病棟がご自宅に帰っていただく前の、いわゆる回復期段階の患者さんがご入院される病棟となっております。主にHALに関わっているのが脳神経外科です。

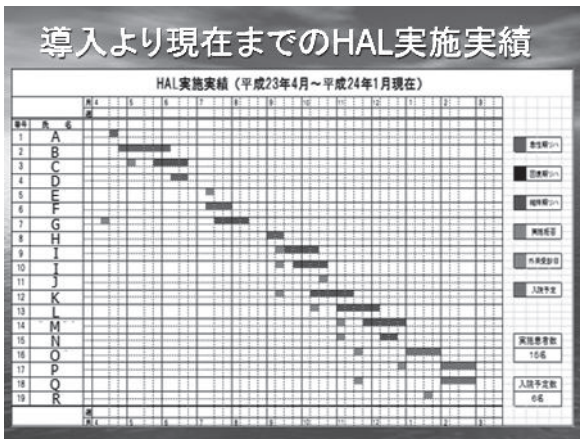


HALの使用目的ですけれども、「脳の可塑性」と書いていますが、脳は元々改善しないというように言われていましたが、機能がどんどん置き換わって、麻痺が軽減していくと言われるようになってきました。それを「可塑性」というように対応されているのですけれども、私個人としてはその時期の患者さんに利用いと思っておりました。しかし、HALを導入した時にちょうど良いタイミングで、NHKの番組で福祉ネットワークという30分ほどの番組があり、ご自宅に帰られている患者様が通院することで改善しましたというような内容でした。その結果、患者様からお電話をいただくケースが増え、これは少し対応が必要だということで、HAL目的のリハ外来診察をお願いするという運びになるのですが、それがこちらのスライドになります。



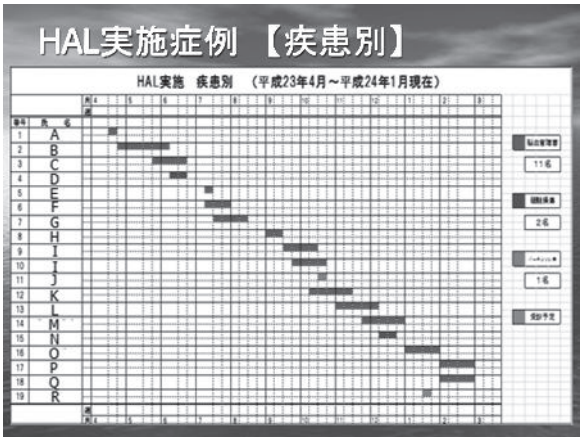
脳神経外科医と相談し、HAL目的におけるリハ外来診察をしていただきました。維持期（生活期）が、先ほどの慢性期にあたります。対象は、当面は脳血管障害患者（脳卒中の患者さん）といたしました。HAL導入時に最初に入れられたのが山口県の病院だったのですけれども、私自身がそちらで勉強会があった際に、これは装着してから少し時間がかかるということを学びましたので、慣れていただくのにやはり１週間は要るだろうと考えました。外来で来ていただいて、その場で20分して効果がわかるかと言うと、そうではありませんので、このような４週間入院と設定させていただきました。

入院病棟は、なかなか急性期病棟に入れませんので、主に２L病棟、３L病棟という回復期の建物としましたが､現在は２L病棟を中心に行っています。



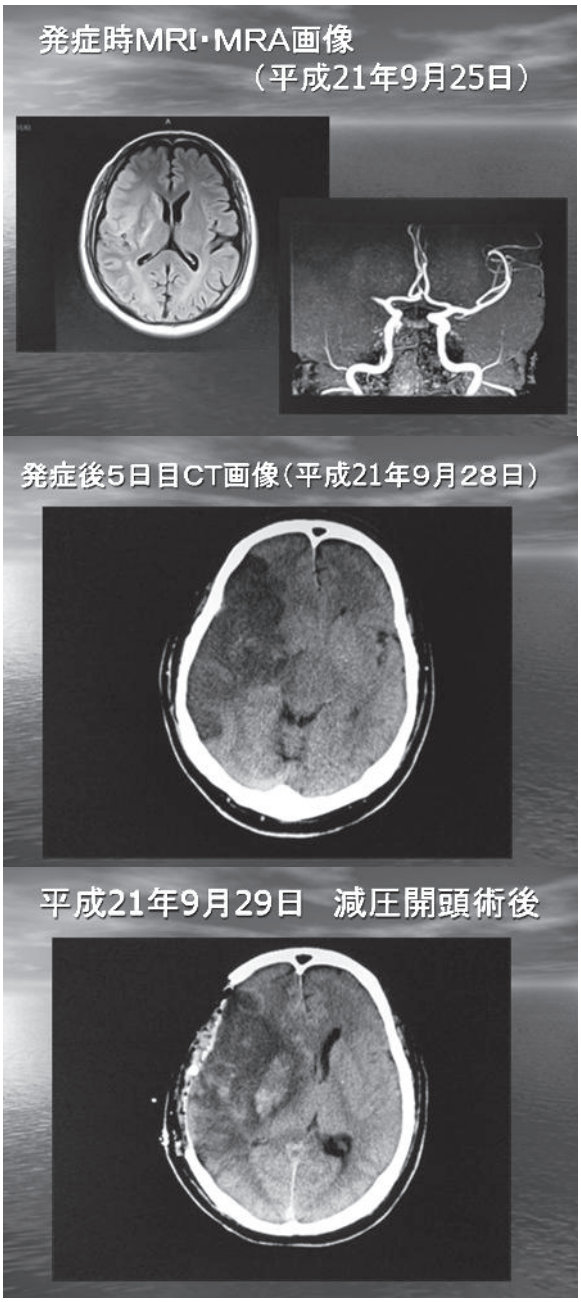
導入より現在までのHAL実施実績は急性期リハ（スライド グラフ中 赤)、回復期リハ（同黒)、維持期リハ（同青)、慢性期ですけれども、青色（維持期リハ)がどんどん増えていっている状態にあります。

実施症例は、赤色が脳血管障害で、脊損損傷の患者さんが青色、パーキンソンの患者さんが黄色ですけれども、ほとんどが赤色の患者さん（脳血管障害）です。



こちらはHALとパソコンの画面が映っていまして、その間にケーブルを介してルーターという無線通信で送っている状況です。このような形で、患者さんが歩くと重心が移動します。本来は八の字のきれいな軌跡を描くのですけれども、片麻痺の患者さんは割と一部だけ、それからこちらの部分に筋収縮が見られますので、こちらがいい方の足で、こちらがちょっと不得手というような信号になります。

１人目の紹介ですけれども、60歳の男性で、HAL導入前に当院でリハビリを受けられた、かなり重度の左片麻痺の方です。心原性脳梗塞と右中大脳動脈の閉塞症で、その後入院されて、４日後に出血も起こされた方です。こちらがCT画像ですけれども、こちら側が左側になります。こちら側が右側になりますので、この患者様は左の片麻痺を呈している患者さんで、こちらの方の広範囲な部分が損傷を受けています。こちらが血管画像です。これが中大脳動脈ですが、完全に根っこのところで血流が遮断していますので、脳に血液が送れないという方です。この方が４日後に出血も起こされて、かなり左側に脳が押されているのがわかると思いますが、これを除圧するために、９月に減圧開頭術をされ、12月にまた骨を戻されています。

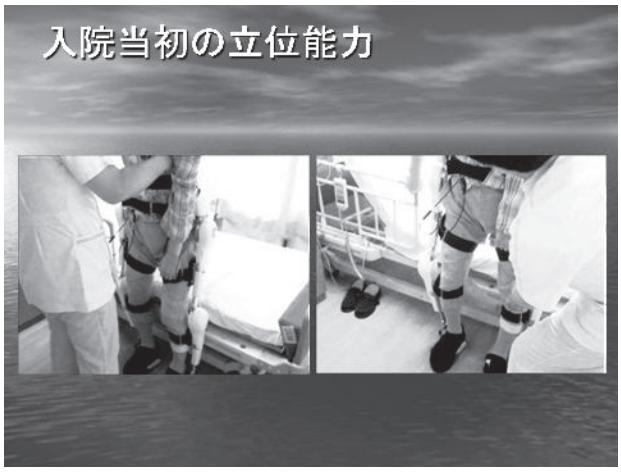


当初は、理学療法、作業療法、言語聴覚療法を実施されていまして、12月７日にようやくリクライニング式の車椅子にて離床開始、１月頃より起立・歩行訓練、３月頃から平行棒内歩行訓練開始と書いていますが、ほとんどできていなかったという患者さんです。５月19日に転院されまして、その後、テレビ番組を観られて、お電話をいただき、脳神経外科医と相談の上、入院していただくという流れになりました。運動麻痺のレベルは以前退院された時とほとんど変わりなく、入院時にCTを撮りましたが、やはりこのような変わらない画像でした。脳室がかなり大きくなってしまっていることも認められます。

お電話をいただいたのは奥様です。ご主人が病気で奥様から電話をいただくというケースが結構多いのですが、家の中で車椅子のみで、ほとんど動いてくれないので、体を動かすようにしていってほしいということがありました。リハビリテーションの意欲の向上というところもあります。今回この患者さんは、理学療法・作業療法に加え、言語聴覚療法も介入しています。

運動障害で、これはⅠ、Ⅰ、Ⅱと書いていますが、正常をⅥという数字で表しています。ということは、Ⅰが一番悪い数字ですので、ほとんど動かせないという所見になります。動作的には全てを介助されているという患者様です。

こちらが入院されてHALを開始した時の状態ですが、このように装着しています。この当初は、やはり20分ぐらいの装着時間がかかりました。早くなってきますと、10分ぐらいで着けられるようになります。いきなり歩くのではなく、まず立位から確認して、その感覚を掴んでもらうという練習を行い、約１週間してから初めてHALを着けて歩行します。義足とも似ているところがあるかもしれませんが、やはり患者さん側にも動かされているという感じがなかなか伝わりにくくて、私の手がふさがっていたので、足で振り出しの介助をさせていただいているという、ちょっと失礼ですけれども、このような形で歩いていただきました。



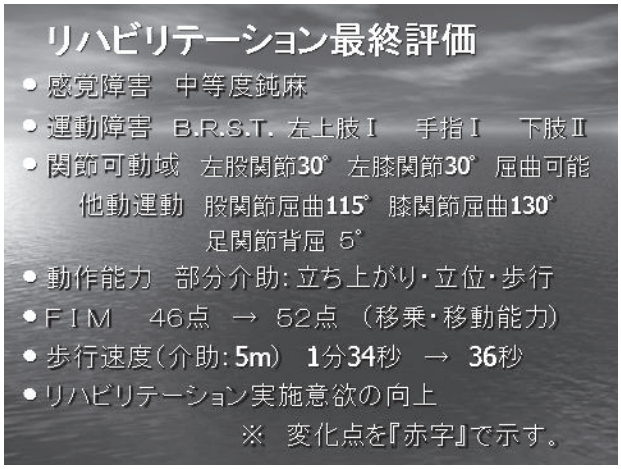
４週間後ぐらいですけれども、退院間近では先ほどよりも上手になられているかと思います。やはり本人の中で歩けるという自信が芽生えてくることで、意欲の向上を強く感じると、患者さんもおっしゃっていました。運動麻痺の状態はほとんど変わりませんが、関節可動域の改善や動作能力が、立ち上がり・立位・歩行が部分的な介助となりました。

そして何より大きいと思いましたのが、リハビリ実施意欲の向上でした。自宅でも歩いていただきたいので、ご家族にもご指導しました。やはり奥様の体の大きさよりも患者様の方が大きい状態ですので、転倒の可能性が高いかなということで、練習はしましたが、ベッド柵を使って、その周りを歩いていただくということを選択しました。

ここはボランティアですけれども、患者さんの家に連絡し、その後の状態を見に行かせていただきました。このような形でベッド柵の周りを継続して歩いていただき､その場面を見させていただきました。

トイレ動作は、全介助でされていましたので、このように一応手すりは付けられていますが、この方は立ち上がりがご自身でできるようになってこられましたので、手すりの位置が遠いということにようやく気付かれたようでしたので、手すりをもう少し手前に付けてもらうように変更をお願いしました。

この方は最終的に左足がよく出るようになりましたということを、おっしゃっていました。ただ、左膝が伸びた状態で歩かれていたと思うのですけれども、膝を曲げて歩くというところまではまだ難しかったです。外来通院でもHALのリハビリができたらということをおっしゃっていたのですが、再度連絡がありまして､調整後に、２回目、３回目と行っています。このような状態で、当初よりはやはり動きが良くなられています。

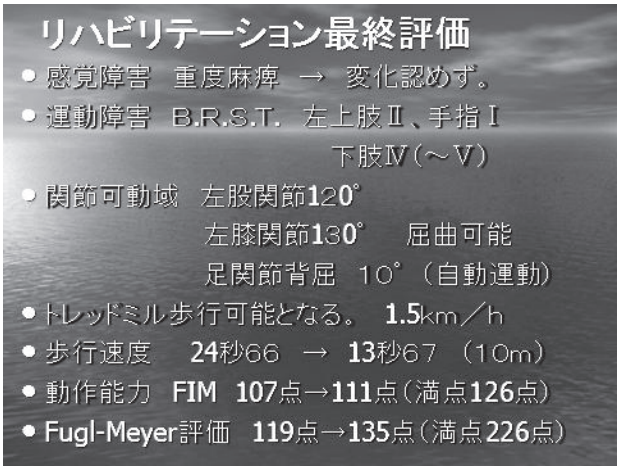


２症例目は64歳の男性の方です。この方も連絡を受けて来ていただいたのですが、脳出血で、こちらの部分、被殻から放射冠に出血と、脳室と言われる水の含んだ部分の拡張が見られました。

この方は先ほどの方より歩けましたが、室内での１本杖歩行は可能ですけれども、左の感覚が全くなく、屋外で少しの段差があると、もう怖くて歩けない。それで階段もしにくいということでした。今回は歩行訓練に集中したいとのことで、作業は行わず、理学のみで行いました。

先ほどの方に比べ､運動のステージは､手はちょっと動かせませんが、足は真ん中ぐらいの動きがあるというのがⅢになります。こちらは入院当初の、HALをしていただく前の歩行です。脊髄損傷の方と違い、この方の場合は右足ですけれども、一応いい方の足と言われる軸足がありますので、主に左側の改善が目的になります。

外を歩くのが怖いとおっしゃっていましたが、退院の時はこのような形でかなりスイスイと歩かれるようになられました。また、何かこういう違ったところ、舗装されていないところに上がったりするのが困難でしたが、何の怖さもなく歩けるようになったとおっしゃっています。



麻痺全部が治るかと言うと、なかなか難しいところがあります。ここですね。下肢がⅢでしたが、ⅣからⅤと書かせていただいたのは、この方は運動麻痺のレベルに若干変化がありました。それがこちら

の画像ですが、入院当初、左麻痺ですので、こちらの足が麻痺されているのですが、こちらは今いい方の足を上げてもらっています。皆さんは上がると思いますけれども、麻痺されている方はこのように上げることが難しい方が多いのです。HAL実施後３週目ぐらいですけれども、右足は変わらずしっかり上げていただけます。脳卒中片麻痺患者さんにとっては、特に膝を曲げた状態で足首を上げることがかなり難しい運動なのですがこのように上がるようになりました。

足首が上がるということが全体的な動作にも影響してくるのかなと思うのですが、屋外を歩く際にもしっかり歩けるようになられ、トレッドミルも怖くて歩けないとおっしゃっていたのですが、私が後ろに付いての介助の下ではできたということに対して喜ばれていました。

アンケートを取らせていただきました患者さんの感想です。トレッドミル歩行、今の機械の歩行が時速0.7kmから0.8kmでも怖かったが、速度が改善されて、身体全体のバランス、安定性が増しました。ゴルフが大好きで、そのゴルフができるようになりました。ただし、少し不満点と言いますか、障害の左足階段昇降がまだちょっと難しい。怖い。疲労しやすく回復が遅いので、疲れた時の足首がやはり怖くて不安定になります。再度ロボットスーツHALを使用したいということでした。後で送ってきてくれた写真ですけれども、このようにゴルフもしっかりなされています。

HAL運営における問題点は、よく挙げられますが、まだ１人で対応するのが難しいというところで、２人ぐらいの人員と時間がかかります。HAL自体外から装具のように着けるため、装着がうまく着かないと歩けませんので、その辺りの難しさがあります。レンタル費用が高いので、病院で負担しなければなりません。これは導入施設が、まだ本数が少ないということも大きな原因だと思います。一番頑張らなければならないところですけれども、やはり症例を集めて効果を出し、「これは効果があるんだ。使っていくべきだ」ということをやっていかなければなりません。どのような病気の方に用いることが可能かについては、当院では今できていませんが、やはり急性期・回復期・慢性期という病気の経過した時間の中での訓練がございますが、それぞれが考えていかなければならないということになります。

HALの臨床現場における有効性は、徐々にではありますが研究されています。その効果も実証されつつありますが、当院としてもまだまだ頑張っていかなければならないと思っています。慢性期（スライドでは「生活期」）におきましては、状態のよくない方がリハビリテーションを求められてきているということがありました。この辺りは厚生労働省が厳しいのですが、その中で、私達は限界をつくらずに対応していく必要があると思っています。また、今回の症例を通じて、急性期・回復期・慢性期の地域連携の重要性も考えさせられました。

現在、当院においては、今回ご報告させていただきました通り、慢性期のリハビリテーションが中心となっています。これらの経験から、当初、運動麻痺の改善は初期でないと難しいと思っていました

が、第２症例で挙げさせていただきましたように、運動麻痺の回復が出ている方について、他の病院からもお聞きします。急性期・回復期・維持期といった病期の問題は、脳の可塑性において大きな影響を与える因子であることは事実ですけれども、やはり回復しようとする患者さんの気持ちを大事にして、チャレンジしていくということが重要だとあらためて痛感しています。

以上です。ご清聴ありがとうございました。

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著書

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The effects of low and high intensity exercises on four basic taste sensitivities.	Nakanishi Y, Inoue Y, Ito T, Nethery VM	Northumbria University, England	2014年12月	The International Sport & Exercise Nutrition Conference
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氏　　名　　小笠原　一生
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日本アスレティックトレーニング学会，American college of sports medicine

著書・論文等（雑誌論文含む）

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The external force model for determining the f rontal plane knee loading pattern —Implication for the mechanism of non-contact anterior cruciate ligament injury —.	Issei Ogasawara, Shumpei Miyakawa, Shigeyuki Wakitani.	4(1), 19-28, 2014.	Mukogawa journal of health and exercise science
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氏　　名　　小柳　好生
所属学会　　日本体力医学会，日本体育学会，日本臨床スポーツ医学会

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学会のシンポジスト・パネリスト・コメンテーター等

タイトル	発表者	開催地	発表年月	学会名
スポーツ医学的研究（座長）	小柳　好生	長崎県	2014年9月	第69回日本体力医学会

講演会（教育講演会・研修会含む）

タイトル	発表者	開催地	発表年月	学会名
芦屋市スポーツリーダー認定講習会	小柳　好生	兵庫県芦屋市	2014年２月	芦屋市教育委員会
トレーニングとコンディショニング	小柳　好生	大阪府	2014年８月31日	（公財）日本バレーボール協会

その他研究・教育活動

平成26年度　　日本オリンピック委員会強化スタッフ
平成25年～　　日本アスレティックトレーニング学会評議員
平成21年度～　日本体育協会アスレティックトレーナー連絡会議運営員会委員
平成23年度～　日本体育協会アスレティックトレーナー試験委員会委員
平成26年度～　兵庫県体育協会スポーツ医・科学委員会委員
平成22年度～　兵庫県スポーツ指導者協議会理事
平成26年度　　バレーボール全日本ユース女子チーム　アスレティックトレーナー
　　第10回バレーボールアジアユース女子選手権大会帯同

氏　　名　　武岡　健次
所属学会　　日本理学療法士学会　日本体力医学会　日本医学写真学会

研究・教育活動

1．生活と健康について　講師　2014年10月　主催 団地マネージメント研究会　近隣の高齢者の皆様に日常生活における注意点や健康に生活するための基本について講演を実施した。
2．園児の体力向上について　講師　2014年09月　武庫川女子大学付属幼稚園の保護者の皆様に，体力測定を実施した結果を報告し，子供たちの体力向上について講演した。
3．武庫川女子大学付属幼稚園児の体力測定　2014年08月　武庫川女子大学付属幼稚園児を対象に，握力，開眼片脚起立，幅跳び，柔軟性，敏捷性の体力測定を実施した。
4．高齢者の運動教室　家庭でできる簡単トレーニング　講師　2014年07月　主催　生涯学習鳴尾大学講座　近隣の高齢者を対象に，転倒予防に関するトピックスを紹介し，椅子に座ってできる簡単な運動を実施した。
5．介助方法の考え方と理論　講師　2014年07月　主催　阪神福祉センター　新生園利用者の皆さんの介助の方法についての考え方と理論を講演し，実際の介助方法について実演した。
6．転倒予防と簡単トレーニング　講師　2014年06月　主催　武庫川女子大学栄養科学研究所　講演　近隣の高齢者に転倒のメカニズム，転倒のリスク，転倒しやすい時間や場所，転倒に有効なトレーニングについて講演を実施した。

氏　　名　　田中　繁宏
所属学会　　日本内科学会，日本アレルギー学会，日本呼吸器学会，
日本臨床スポーツ医学会，日本体力医学会，日本臨床運動療法学会，
日本教育医学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
Commotio Cordis：importance of awarenes	Shigehiro. Tanaka	Vol.4(1), 31-37, 2014	Mukogawa J Health and Exercise Science,

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
若年女生でのDEXA法による体脂肪と超音波法による皮下脂肪厚の関係	宮本芙美香，田中　繁宏	大阪	p59 2014年（9月）	第33回臨床運動療法学会
インピーダンス法による内臓脂肪とエコーによる皮下脂肪厚との関係	丸尾　　彩，宮本芙美香 田中　繁宏	東京	Vol22 (4)S208 2014年（11月）	第25回日本臨床スポーツ医学会

氏　　名　　田中　新治郎
所属学会　　日本体育学会　日本体育科教育学会　日本教育方法学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
「すべての子どもに豊かな運動文化を」の真価を問う	田中新治郎	2014年1月 8頁-11頁	『たのしい体育・スポーツ』第33巻第1号
生きる力につながるグループ学習の条件―グループ学習の基本的な要素―	田中新治郎	2014年5月 30頁-33頁	『たのしい体育・スポーツ』第33巻第4号
新たな運動文化論に向けて（1）―主体者形成論の見直し―	田中新治郎	2014年10月 22頁-25頁	『たのしい体育・スポーツ』第33巻第8号
大学における教員養成の充実―岩田康之氏の講演に寄せて―	田中新治郎	2014年12月 103頁-104頁	大学間連携共同教育推進事業「教員養成高度化システムモデルの構築・発信」『中間報告書』

学会発表（口頭発表含む）講演会（教育講演会・研修会含む）

タイトル	発表者	開催地	発表年月	学会名
同志会で学んだ成果 ―コミュナル学び―	田中新治郎	神戸大学附属特別支援学校	2014年10月23日	学校体育研究同志会

氏　　名　　林　　義孝
所属学会　　日本リハビリテーション医学会・日本理学療法学術学会・日本義肢装具学会

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
脳卒中片麻痺患者における咳嗽時の体幹筋活動 ―麻痺側・非麻痺側の比較―	玉村　悠介，林　　義孝 新田　　勉，松浦　道子 吉川　　創，糸田　昌隆 田中　信之	神奈川県 パシフィコ横浜	2014年 ５月30日（金）～ ６月１日（土）	第49回日本理学療法学術大会
脳卒中片麻痺患者における随意的咳嗽力と咳反射テストの反応時間との関係について	玉村　悠介，林　　義孝 新田　　勉，勝田　有梨 糸田　昌隆，田中　信之	東京都 京王プラザホテル	2014年 ９月６日（土）～ ９月７日（日）	第20回日本摂食嚥下リハビリテーション学会学術大会

講演会（教育講演会・研修会含む）

タイトル	発表者	開催地	発表年月	学会名
切断者リハビリテーション～その歴史から未来に求められること～	林　　義孝	岡山	2014年10月19日	第30回に本義肢装具学術大会

氏　　名　　堀江　登
所属学会　　日本生理学会，日本血栓止血学会，日本食品科学工学会，日本栄養・食糧学会
The International Society on Thrombosis and Haemostasis

氏　　名　　松尾　善美
所属学会　　日本リハビリテーション医学会，日本循環器学会，日本体力医学会
心臓リハビリテーション学会，日本呼吸ケア・リハビリテーション学会
日本腎臓リハビリテーション学会，日本摂食・嚥下リハビリテーション学会 他

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
認知負荷を含む動作・運動分析の手順とクリニカル・リーズニング（歩行障害を中心に），訪問理学療法の実際，パーキンソン病に対する標準的介入構築の必要性	松尾善美（編著）他	2014年１月 p.2-20, 205-217, 218-229	パーキンソン病の標準的理学療法介入，㈱文光堂
急性期での医学的治療と理学療法の役割	井上悟，松尾善美（編著）他	2014年５月 p.2-14	回復期につながる急性期理学療法の実際，㈱文光堂

タイトル	著者	発刊年月ページ	雑誌名
ベストプラクティスと脳卒中理学療法の結合	奈良勲，松尾善美（編著）他	2014年9月 p.43–56	脳卒中理学療法ベストプラクティス―科学としての理学療法実践の立場から―，㈱文光堂
The Feasibility of Expiratory Resistive Loading Using the Threshold Inspiratory Muscle Training Device	Yoshimi Matsuo, Yukio Yanagisawa, Lawrence P Cahalin	2014年9月 25:92–95	Cardiopulmonary Physical Therapy Journal
Effect of expiratory resistive loading on orbicularis oris muscle activity in expiratory muscle strength training	Yukio Yanagisawa, Yoshimi Matsuo, Hisato Shuntoh, Noriaki Horiuchi	2014年2月 26:259–261	Journal of Physical Therapy Science
心不全入院患者の再入院危険因子と在院期間の検討	池田　真治，竹内　香理 椙　　平司，藤田　雅史 松尾　善美	2014年1月 19:31–35	理学療法兵庫
心臓手術前より歩行が困難な症例の特徴	西村　真人，松尾　善美 大久保裕介，古田　　宏 河村　知範，前宏　　樹 東　　修平，頓田　　央 東上　震一	2014年2月 19:70–77	心臓リハビリテーション
訪問リハビリテーション利用者に対する災害時の安否確認対策―災害伝言ダイヤルを用いて―	柳澤　幸夫，中村　武司 直江　　貢，黒上公美子 山本　　修，佐藤　俊徳 瀬戸　裕二，松尾　善美	2014年3月 3:2–4	理学療法徳島
２型糖尿病患者に対する有酸素運動実施前後の血糖値の提示が動機づけに与える影響	笠原　正資，松尾　善美 柿花　宏信，森下　真帆 山下　　拓，高田　健司 深水　真希	2014年3月 31:252–258	プラクティス
兵庫県下における開心術後の心臓リハビテーションの現状と今後課題	本多　　祐，久保　清景 谷口　良司，民田　浩一 藤久　　和，藤田　雅史 水谷　和郎，松尾　善美 北井　　豪	2014年7月 19:236–240	心臓リハビリテーション

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
維持血液透析患者の姿勢変換時における心血行動態と自律神経活動の変動に関する検討	望月　寿幸，松尾　善美 森久　賢一，佐々木眞弓 田端　作好，福田　豊史 矢嶋　息吹	福岡市	2014年3月	第4回日本腎臓リハビリテーション学会

タイトル	発表者	開催地	発表年月	学会名
長期療養高齢患者の運動機能が栄養状態に及ぼす影響（第一報）―栄養サポートチーム（NST）導入前の検討―	矢野　広宣，松尾　善美 柳澤　幸夫，直江　貢 國友　一史	横浜市	2014年５月	第49回日本理学療法学術大会
徳島県における理学療法士の吸引行為に関する実態調査	柳澤　幸夫，中村　武司 松尾　善美	横浜市	2014年５月	第49回日本理学療法学術大会
慢性心不全患者における下肢筋酸素動態の特徴	池田　真治，松尾　善美 小林　英史，竹内　香理 白井　一郎，椙　平司 大島　富雄，藤田　雅史	横浜市	2014年５月	第49回日本理学療法学術大会
心臓外科手術後早期の自覚的運動強度による運動指導は妥当か？（第一報）	西村　真人，松尾　善美 大久保裕介，古田　宏 河村　知範，畔柳　智 東上　震一	京都市	2014年７月	第20回日本心臓リハビリテーション学会
心筋梗塞症患者におけるソーシャルサポートが心臓リハビリテーションの効果に与える影響	川崎　健作，松尾　善美 七星　雅一，三枝　秀明	京都市	2014年７月	第20回日本心臓リハビリテーション学会
植込型補助人工心臓装着患者に対する運動療法における取り組み	神田　龍馬，松本ゆかり 鎌田　理之，松尾　善美 橋田　剛一，岩崎　朋之 神崎万智子，大谷　朋仁 山口　修，澤芳　樹 坂田　泰史	京都市	2014年７月	第20回日本心臓リハビリテーション学会
待期的開胸術患者の術前eGFRは術後離床経過の予測因子である	河村　知範，西村　真人 松尾　善美，大久保裕介 古田　宏，中川幸太郎 永井　佑典，毎熊　青葉 東上　震一	京都市	2014年７月	第20回日本心臓リハビリテーション学会
慢性心不全患者に対する活動量計を用いた在宅型運動管理の効果	高瀬　広詩，松尾　善美 東根　孝次，小田　実 真鍋　誠，嶋田　悦尚 小倉　理代，日浅　芳一	京都市	2014年７月	第20回日本心臓リハビリテーション学会
兵庫県内の老健及び通所リハに勤務するセラピストへのアンケート調査	片山　里佳，浅井　剛 柳本　智，掘井　吉幸 戸田　勝也，松尾　善美 上嶋　健治，野村　史郎	京都市	2014年７月	第20回日本心臓リハビリテーション学会
外来通院における心臓リハビリテーションが日常的身体活動量に与える影響	戸田　勝也，浅井　剛 柳本　智，掘井　吉幸 片山　里佳，松尾　善美 上嶋　健治，野木　佳男	京都市	2014年７月	第20回日本心臓リハビリテーション学会

タイトル	発表者	開催地	発表年月	学会名
心臓リハビリテーション施行患者の下肢運動時の姿勢が循環応答に与える影響	掘井　吉幸，浅井　剛 柳本　智，戸田　勝也 片山　里佳，松尾　善美 上嶋　健治，野木　佳男	京都市	2014年７月	第20回日本心臓リハビリテーション学会
待期的開胸術予定の維持血液透析患者特性について	河村　知範，西村　真人 松尾　善美，大久保裕介 古田　宏，中川幸太郎 永井　佑典，毎熊　青葉 東上　震一	京都市	2014年７月	第20回日本心臓リハビリテーション学会
在宅療養者における座位姿勢および呼気負荷圧の違いによる舌骨上筋群の活動	松尾　善美，柳澤　幸夫	東京都新宿区	2014年９月	第20回日本摂食・嚥下リハビリテーション学会学術大会
在宅療養中の高齢パーキンソン病患者における栄養状態と運動機能	奥山　紘平，松尾　善美 上田　祥博	東京都新宿区	2014年９月	第20回日本摂食・嚥下リハビリテーション学会学術大会
吸気抵抗負荷時における舌骨筋群の筋活動特性 ～Shaker exerciseとの比較～	柳澤　幸夫，松尾　善美	東京都新宿区	2014年９月	第20回日本摂食・嚥下リハビリテーション学会学術大会
維持血液透析患者の姿勢変換時における心血行動態と自律神経活動および圧受容器反射感受性の変動に関する検討	望月　寿幸，松尾　善美 森久　賢一，佐々木眞弓 田端　作好，福田　豊史 矢嶋　息吹	大阪市	2014年９月	第33回日本臨床運動療法学会学術集会
理学療法士における喀痰吸引の実態調査～現状およびインシデントについて～	柳澤　幸夫，中村　武司 松尾　善美	徳島市	2014年10月	第25回徳島県理学療法士学会
壮年循環器疾患患者の復職に関わる要因	村上　直也，高瀬　広詩 松尾　善美，平林　伸治 小田　実，小倉　理代 日浅　芳一	徳島市	2014年10月	第25回徳島県理学療法士学会
長期療養高齢患者の運動機能が栄養状態に与える影響	矢野　広宣，松尾　善美 柳澤　幸夫，直江　貢 國友　一史	徳島市	2014年10月	第25回徳島県理学療法士学会
側腹筋厚が咳嗽機能に与える影響―若年者と高齢者の比較―	井坂　昌明，堀　竜次 松尾　善美	奈良市	2014年10月	第24回日本呼吸ケア・リハビリテーション学会

タイトル	発表者	開催地	発表年月	学会名
肺癌術後離床に対する影響因子の検討	木原　一晃，鎌田　理之 松尾　善美，橋田　剛一 川村　知裕，平田　陽彦 藤村まゆみ，井口　和江 木島　貴志，奥村明之進	奈良市	2014年10月	第24回日本呼吸ケア・リハビリテーション学会
経鼻酸素の連続・同調による投与方法で酸素化が異なった一症例	柳澤　幸夫，竹田　絵理 松尾　善美，山村篤司郎 堀内　宣昭	奈良市	2014年10月	第24回日本呼吸ケア・リハビリテーション学会
入院治療を要した壮年循環器疾患患者における退院後の復職状況	高瀬　広詩，松尾　善美 平林　伸治，村上　直也 小田　　実，小倉　理代 日浅　芳一	神戸市	2014年11月	第62回日本職業・災害外科学会
在宅介護者における災害時避難行動の意思決定に及ぼす要因の検討	柳澤　幸夫，中村　武司 直江　　貢，黒上公美子 山本　　修，佐藤　俊徳 瀬戸　裕二，松尾　善美	高知市	2014年11月	第43回四国理学療法士学会

講演会（教育講演会・研修会含む）

タイトル	発表者	開催地	発表年月	学会名
呼吸器疾患の理学療法	松尾　善美	京都市	2014年７月	京都心臓リハビリセミナー
呼吸理学療法	金尾　顕郎，千葉　一雄 小林　　茂，松尾　善美 堀　　竜次，本田　憲胤	大阪市	2014年７月	第11回呼吸リハビリテーション講習会
パーキンソン病の理学療法：トピックス	松尾　善美	京都市	2014年11月	㈳日本理学療法士協会基礎講習会「パーキンソン病の理学療法」
循環器疾患のフィジカルサイン	松尾　善美	神戸市	2014年12月	㈳日本理学療法士協会基礎講習会「内部障害に対する理学療法の進め方の基本」

氏　　名　　松本　裕史
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　　日本行動医学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
途上国におけるスポーツ活動を通じたライフスキル教育プログラムの作成：セブ市の教育的課題と育成の対象とする心理社会的スキルの特定	渋倉　崇行，松本　裕史 笠巻　純一，西田　順一	Vol.32, 11-16. 2014	新潟体育学研究

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
Physical activity promotion strategy for Japanese young women using stair climbing as an environmental sustainability intervention	Hiroshi Matsumoto, Philip M. Wilson, and Diane E. Mack	San Diego	Mar, 2014.	International Society of Behavioral Nutrition and Physical Activity 2014 Annual Meeting

氏　　名　　目連　淳司
所属学会　　日本体育学会，日本体力医学会，日本トレーニング科学会
　　兵庫体育・スポーツ科学会

氏　　名　　森山　賢治
所属学会　　日本内科学会，日本糖尿病学会，日本内分泌学会，日本甲状腺学会，
　　日本神経内分泌学会，日本東洋医学会，日本肥満学会，日本分子生物学会，
　　日本薬学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
「甲状腺疾患と薬剤」	森山　賢治，田上　哲也	p94-97, 2014.	甲状腺疾患診療マニュアル 田上哲也編，改訂第二版. 診断と治療社.
成長ホルモン／インスリン様成長因子-1のエネルギー代謝制御における分子基盤の解明.	森山　賢治，二若　久美 田上　哲也	p173-176. 37号，2014.	成長科学協会研究年報

タイトル	著者	発刊年月ページ	雑誌名
成長ホルモン／IGF-1シグナル下流の転写因子群と核内受容体による糖・脂質・エネルギー代謝調節メカニズムに関する研究.	田上　哲也，森山　賢治	p123-130. 37号，2014.	成長科学協会研究年報

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
合成活性型ビタミンＤ３の転写活性の比較評価.	福田　佑紀，森山　賢治	福岡	2014年４月	第87回日本内分泌学会学術総会
IGF-1以降のエネルギー代謝調節に関与する標的遺伝子の探索.	根津　祥子，森山　賢治	福岡	2014年４月	第87回日本内分泌学会学術総会
GHのエネルギー代謝調節に関する基礎的検討.	主田　綾佳，森山　賢治	福岡	2014年４月	第87回日本内分泌学会学術総会
甲状腺ホルモンおよびビタミンDによる糖・脂質・エネルギー代謝に関わる遺伝子の発現調節	田上　哲也，二若　久美 森山　賢治	福岡	2014年４月	第87回日本内分泌学会学術総会
Pl3K/Akt経路のシグナル伝達における基礎的検討.	根津　祥子，森山　賢治	大阪	2014年５月	第57回日本糖尿病学会学術年次総会
JAK/STAT経路によるエネルギー代謝調節に関する基礎的検討.	主田　綾佳，森山　賢治	大阪	2014年５月	第57回日本糖尿病学会学術年次総会
IGF-1のエネルギー代謝調節における分子メカニズムの基礎的検討	根津　祥子，森山　賢治	京都	2014年10月	第63回薬学会近畿支部総会
成長ホルモンのエネルギー代謝に関する基礎的検討	主田　綾佳，森山　賢治	京都	2014年10月	第63回薬学会近畿支部総会
活性型ビタミンＤ３の転写活性化に関する検討	福田　佑紀，森山　賢治	京都	2014年10月	第63回薬学会近畿支部総会

講演会（教育講演会・研修会含む）

タイトル	発表者	開催地	発表年月	学会名
糖尿病治療のMinimal requirementとexpertise	森山　賢治	京都	2014年６月８日	静薬学友会関西支部総会
糖尿病治療の現状とこれから	森山　賢治	西宮	2014年10月26日	第16回在日中国人生命科学協会学術年会

氏　　名　　山添　光芳
所属学会　　日本分子生物学会，日本癌学会，日本再生医療学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
Potential for Tumorigenesis and Repair of Osteochondral Defects by oPS Cell Transplantation in Rat.	Mera, H., Takigami, J., Tamamura, Y., Itokazu, M., Yamazoe, M., ashimoto, Y., Endo, N. and Wakitani, S.	2014 Vol.1 No.1 pp.39–50	American Journal of Tissue Engineering and Stem Cell
Compensatory functions and interdependency of the DNA-binding domain of BRCA2 with the BRCA1-PALB2-BRCA 2 complex.	Al Abo, M., Dejsuphong, D., Hirota, K., Yonetani, Y., Yamazoe, M., Kurumizaka, H. and Takeda, S.	2014 Vol.74 No.3 pp.797–807	Cancer Res.

その他研究・教育活動

1．伊藤超短波㈱からの委託研究として，「幹細胞の分化誘導に対する低出力パルス超音波の影響」に関する研究を行っている。
2．朝日大学歯学部，および大阪市立大学医学部との共同研究として，これらの大学の博士課程大学院生らとともに「低出力パルス超音波が筋細胞分化に及ぼす影響」について研究を行っている。

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　　日本リハビリテーション学会，日本整形外科学会，日本骨代謝学会

氏　　名　　渡邊　完児
所属学会　　日本体力医学会，日本体育学会，日本生理人類学会，健康体力栄養学会
　　日本肥満学会

著書・論文等（雑誌論文含む）

タイトル	著者	発刊年月ページ	雑誌名
Measurement accuracy of hand Dynamometers used for physical fitnesstesting	Watanabe K.,Watanabe K.Yoshioka M.	2014. 3, 23–29.	Mukogawa Journal of Health and Exercise Sciense.

学会発表（口頭発表含む）

タイトル	発表者	開催地	発表年月	学会名
運動中のVO_2を推定するための$HR\text{-}VO_2$関係式に関する研究：トレッドミルと自転車エルゴメーターの比較	松井　麻莉，秋田　倫子 奥田　香穂，渡辺　一志 弘原海　剛，渡邊　完児	長崎県	2014年 9 月	日本体力医学会
運動中のVO_2を推定するための$HR\text{-}VO_2$関係式に関する研究：実測値と推定値の比較	秋田　倫子，松井　麻莉 奥田　香穂，渡辺　一志 弘原　海剛，渡邊　完児	長崎県	2014年 9 月	日本体力医学会
月経周期と運動中の脂質代謝に関する基礎的研究	奥田　香穂，松井　麻莉 秋田　倫子，渡辺　一志 弘原海　剛，渡邊　完児	長崎県	2014年 9 月	日本体力医学会
トレハロースが運動パフォーマンスに与える効果の評価	弘原海　剛，渡邊　完児 渡辺　一志，新井　紀恵	長崎県	2014年 9 月	日本体力医学会

健康運動科学「投稿規定」

１．健康運動科学について

「健康運動科学（Mukogawa Journal of Health and Exercise Science；MJHES)」（以下，本誌）は，健康運動科学研究所が発刊する科学雑誌であり，健康・スポーツ科学領域，リハビリテーション科学領域をはじめ，広く健康科学に関する研究論文などを掲載し，人々のquality of life（QoL）の向上に資することを目的とする。

２．投稿資格

本誌に投稿できるのは原則として本学教員とするが，編集委員会が必要と認めた場合には，学外からも投稿を依頼することがある。

３．原稿執筆及び種類

本誌の原稿は別掲の執筆要領にしたがって，日本語または英語で執筆する。原稿の種類は「総説」,「原著」,「短報」,「速報」,「実践研究」などとし，いずれも未発表のものに限る。ただし，論文の内容に応じて編集委員会から種類の変更を求める場合がある。

英文論文や英文抄録を含む場合は，必ずネイティブスピーカーの校閲を受けることとする。

種類の概要

総　　説（Review）：特定の研究分野に関する知見を総合的・体系的にまとめた論文。

原　　著（Original investigation）：本誌の趣旨に沿った内容で，新たな知見（独創性）を示した研究であり，なおかつ完成度が高い論文。

短　　報（Research letter）：独創的かつ研究上の価値があると思われる成績が示されており，原著に準じた体裁でまとめた論文。

速　　報（Rapid Communication）：研究上の価値があると思われる成績が示されており，方法論上の独創性を主張するために緊急を要する論文。

実践研究（Practical investigation）：実践現場での指導法・治療法に関する知見や情報をまとめた内容であり，方法・結果考察など適切に記述されている論文。

原著論文はタイトルページ（原稿執筆要項に記載)、英文抄録、Ⅰ　緒言、Ⅱ 研究対象、方法、Ⅲ　結果、Ⅳ 考察、Ⅴ　謝辞、Ⅵ　引用文献などと記載、図、図の説明文の順序で構成する。短報、速報は原則として原著論文に準ずる。

４．査読制度と論文の採否

本誌では査読制度を設ける。編集委員会は投稿された論文の内容に詳しい適任者（査読委員）を２～３名選定し，査読委員の意見を参考に論文の採否を決定する。なお，本誌に掲載された論文原稿は，原則として返却しない。

５．ヒトを対象とする研究及び動物実験に関する研究倫理基準

ヒトを対象とした研究では，「ヒトを対象とする医学研究の倫理的原則」（ヘルシンキ宣言，1964年，2002年追加）の基準に従う。また，動物実験の場合は「大学等における動物実験について」（文学情第141号，1987年）及び本学の「武庫川女子大学動物実験規程」における指針に従う。

６．論文の投稿

論文の投稿に際しては，原本１部とそのコピー（３部）及び共著者全員が投稿に同意することを示した投稿承諾書（別添）を添えて下記編集委員会宛に送付する。編集委員会は投稿原稿を受け付けた後，投稿者に投稿受理通知書を発行する。また，査読の結果，論文が受理された場合は最終の原本（図，表等を含む）１部と共に電子媒体を下記編集委員会宛に送付する。

７．掲載料

掲載料は原則無料とするが，ページの超過分については編集委員会の議を経て定める。また，写真などカラーページは別途実費を徴収する。

８．著作権

本誌に掲載された論文の著作権は，武庫川女子大学に帰属する。ただし，著作者本人は論文を許諾なしに利用することができる。また，論文は武庫川女子大学リポジトリに搭載し，インターネットを通して公開されるものとする。

―原稿の提出先―
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平成22年６月18日
平成26年２月14日一部追加記載

健康運動科学「原稿執筆要領」

1．原稿の様式

1）原稿は和文または英文とする。原稿はワープロソフト（MS Wordを推奨）を用い，A4判横書きで上下左右に３cmの余白をとる。和文原稿の場合には，全角文字で40字×40行のページ設定とする。英文原稿の場合には，ダブルスペースで印字する。なお，文字の大きさは，いずれも11ポイントとする。原稿の長さは本文（英文抄録あるいは和文抄録，引用文献等を含む）及び図表等（それぞれ１枚とカウント）を含めて20枚以内とする。
2）和文原稿はひらがな，新かなづかいとする。
3）和文の句読点は「,」と「。」にする。英文の場合は，アメリカンスタイルとする（句読点はコーテーションあるいはダブルコーテーションマークの内側に付ける）。
4）字体（ボールド，イタリック，JIS外字など）の指定は，投稿原稿に赤字で指定する。
5）図，表，写真（原則として電子データ）にはアラビア数字で通し番号を付け，挿入箇所は投稿原稿右余白に赤字で指定する。図，表，写真には表題を付け，原則として図と写真は下に，表は上に記載する。また，他の文献から図，表，写真を転載する際は，必ず転載許可を得なければならない。
6）和文・英文原稿ともに単位は原則として国際単位（SI単位）を使用する。また，記号・符号は国際的に慣用されているものを使用する。数字はアラビア数字を使用する。
7）和文・英文原稿における略語は初出時の後の括弧に示し，以下その略語を用いる。
8）項目の表記は，順にⅠ，Ⅱ，Ⅲ，...，A，B，C，...，１，２，３，...，１），２），３），...，⑴，⑵，⑶...，①，②，③…とする。

2．原稿表紙

1）表紙には表題，著者名，所属（住所），連絡先を記入する。その次に英文で表題，著者名，所属，連絡先を記入する。なお，種別は表紙の左上に記入する。
2）Key wordsは，１）の英文連絡先の次に原稿内容が分かるような単語または句を３～５個記入する。各Key words間はコロンで区切る。
3）別刷希望部数（50部単位）を記入する。ただし，50部までは無料とし，それ以上は実費負担とする。
4）編集委員会との連絡として，２）のKey wordsの次に筆頭著者名，連絡先（住所，電話番号，fax番号，e-mailアドレス）を記入する。

3．抄録

1）和文の原著及び短報論文には，第２ページ目に英文抄録（300語以内）を記載する。
2）英文の原著論文には1200字以内の和文抄録を記載する。

4．引用文献

1）引用文献は，引用する箇所の右肩にアラビア数字で上付番号（[1]，[2,3]，[4-7]）を付け，引用文献欄に引用順に記載する。本文で著者名を引用する場合は姓のみとする（田中*，田中と鈴木*，田中ほか*，Tanaka*，Tanaka and Suzuki*，Tanaka et al.*）。

2）引用文献欄における著者名は全員の記載を原則とするが，多数の連名の場合は第３著者までを記載し，第４著者以降を和文では“ほか”，英文の場合は“et al.”とする。
3）引用文献で学術論文の記載形式は，「著者名．表題．雑誌名，巻（号），引用頁－頁，発行年.」の順とする。なお，雑誌名の略は当該雑誌の形式に準ずる。
4）引用文献で書籍の記載形式（単著の場合）は，「著者名．書名．引用頁－頁，発行所，発行所の所在地，発行年.」とし，編著者の場合「執筆者名．該当表題“書名”（編者名），引用頁－頁，発行所，発行所の所在地，発行年.」とする。

【引用文献の記載例】

1．田中繁宏，垂井彩未．２次健康診断での脈波伝搬速度計測導入の試み．学校保健研究，48(5)，448-452，2006.
2．渡辺完児，中塘二三生，田中喜代次，ほか．皮脂厚法による中学生の身体組成評価．体力科学，42(2)，164-172，1993.
3．Ito T, Azuma T, Yamashita N. Changes in forward step velocity on step initiation from backward and forward leaning postures. Osaka R J Phys Educ, 48, 85-92, 2010.
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6．池上晴夫．運動処方．p. 145-151，朝倉書店，東京，1993.
7．前田如矢．健康チェックの基本“健康の科学”（前田如矢，田中喜代次編），p. 1-6，金芳堂，京都，2003.
8．Mahoney C, Boreham CAG. Validity and reliability of fitness testing in primary school children. “Sport and physical activity -moving towards excellence-”（Williams T, Almond L, Sparkes A, editors），p. 429-437, E & FN Spon, London, 1992.
9．文部科学省．学校保健統計調査．http://www.mext.go.jp/b_menu/toukei/chousa05/hoken/kekka/1268813.htm（2010年６月24日にアクセス）

５．校正

初校は著者校正とし，印刷上の誤り以外の加筆・修正・削除は認めない。

平成22年６月18日

投　稿　承　諾　書

健康運動科学　編集委員長殿

論文名 ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

上記の論文を「健康運動科学」に投稿いたします。投稿は，共著者全員の承諾の上で行われること，本論文の内容は刊行物として未発表であり，また他誌に投稿中でないこと，本誌に掲載された論文の著作権は武庫川女子大学に帰属すること，さらに論文は武庫川女子大学リポジトリに搭載し，インターネットを通して公開することに同意いたします。

年　　月　　日

筆頭著者氏名（自署） ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

論文名 ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

所属名 ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

共著者氏名（自署） ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

共著者氏名（自署） ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

共著者氏名（自署） ＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

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（共著者が多数の場合，同紙のコピーを使用してください）

編　集　後　記

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（田中繁宏）

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