KINEMATICS ANALYSIS OF TWO STYLES OF BOW FOR MARTIAL ARTISTS AND AVARAGE STUDENTS

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The aim of this study was to conduct operating analysis of two styles of bow (RITSUREI and ZAREI) for martial artists and average students, and to compare their kinematics characteristic of. Subjects of this study were healthy men (n＝33) who were martial artist group (MA, n＝18) and average student group (AS, n＝15). Subjects conducted RITSUREI and ZAREI three times each. Results of paired t-test, on angular degree parameter of RITSUREI, MA made smaller angular degree of the upper limbs and angular degree of the neck than that of AS. regarding time parameter components, the total time of ZAREI, from beginning of it to stopping, from stopping of it to end, and from beginning of RITSUREI to stopping were significantly shorter than that of AS. MA made several characteristic shown in text. BUDO bow is regarded as practical bow even in social rule when bow teaching is conducted

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KEY WORDS: RITSUREI, ZAREI, kinematics analysis

INTRODUCTION: Bow has been done frequently not only in daily life but also in all sports scene. In Japan, athletes tend to bow at the beginning and ending of all sports scene because it is quite natural to bow at both beginning and ending in BUDO (martial arts) rule. Because they have an martial art consciousness “start with bow and finish up with bow” since old days in Japan, and so Japanese people have more occasions than foreign people to perform bow. Recently, the way the bow is done is taught to social freshman, is learning social etiquette, and many children to let them know social moral.

However, how to bow is different from person like how to walk and throw. It seems that sports experience which each person has is making this kind of difference. Especially, martial artists regard bowing as important thing, so it is considered that their bow is different from that of other sports players. The aim of this study was to conduct operating analysis of RITSUREI (standing bow) and ZAREI (sitting bow) of martial artists and average students, and to compare their kinematics characteristic.

METHODS: Subjects of this study were healthy men (n＝33) who consisted martial artist group (MA, n＝18) and average student group (AS, n＝15). MA consisted of JUDO expert, KENDO expert and AIKIDO expert. Informed consent was obtained from subjects. Subjects were attached 10 markers on top of head, ear, Seventh Cervical spine(C7), shoulder, elbow, Anterior Superior Iliac Spain(ASIS), center of Posterior Superior Iliac Spain (PSIS), great trochanter, knee and lateral malleolus to operating analysis on sagittal plan(Figure 1). Markers were attached on only the right side of the body except for top of head and C7. Subjects conducted six trials that consisted of three times each RITUREI and ZAREI after rehearsal. (Figure 2, 3). This experiment was conducted using two-dimensional analysis. Front-back direction was regarded as the X-axis, and vertical direction relative to the ground

was regarded as Y-axis.

On completion of the experiment, it was expected that bow angular degree and how long bow is done would differ between subjects. Therefore, in this study, object of bow was regarded as person who was respected to unify experiment condition. Factors that were composed of total bow time of each subject, time from beginning to stopping, stopping time, time from stopping to end, angular degree of the upper limbs, angular degree of the neck, and how far great trochanter moved when standing. Comparisons were carried out by unpaired t-test with Welch corrections. Post hoc coefficient correlation was calculated by Pearson product-moment correlation coefficient. Significant level was set at $p < 0.05$.

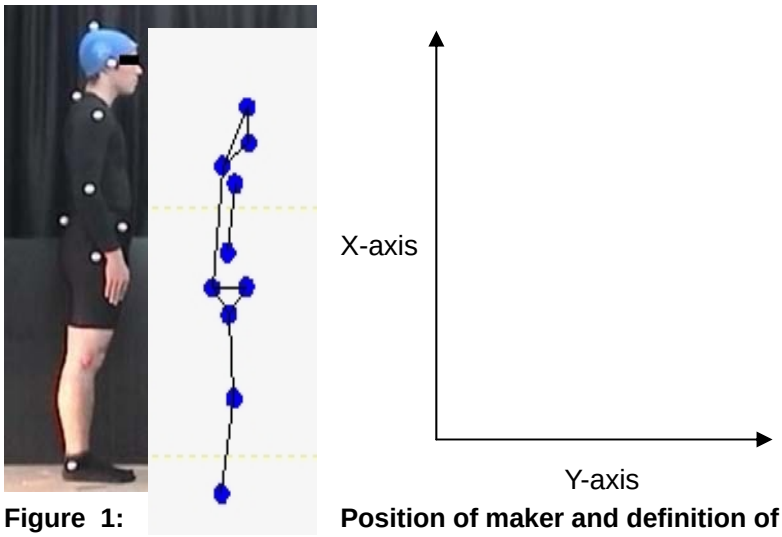

Figure 1: Position of maker and definition of axis

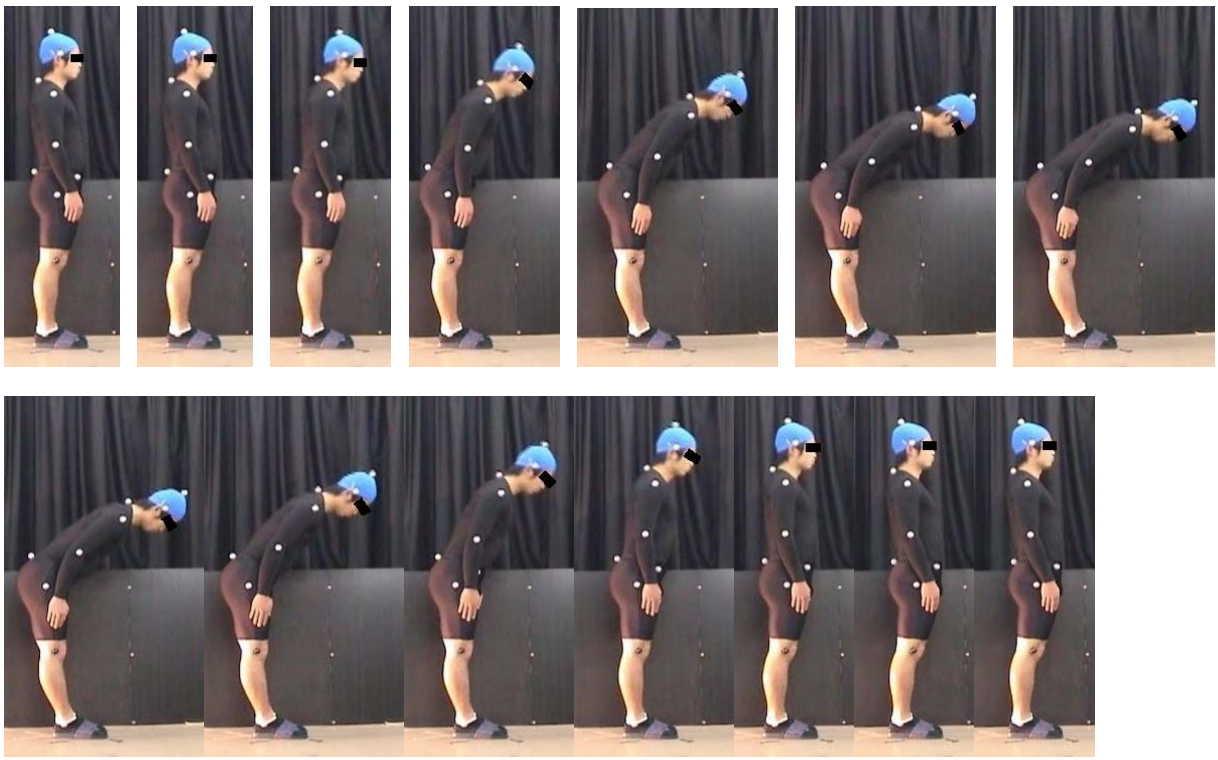

Figure 2: Posture change with sagittal plane of right in RITSUREI

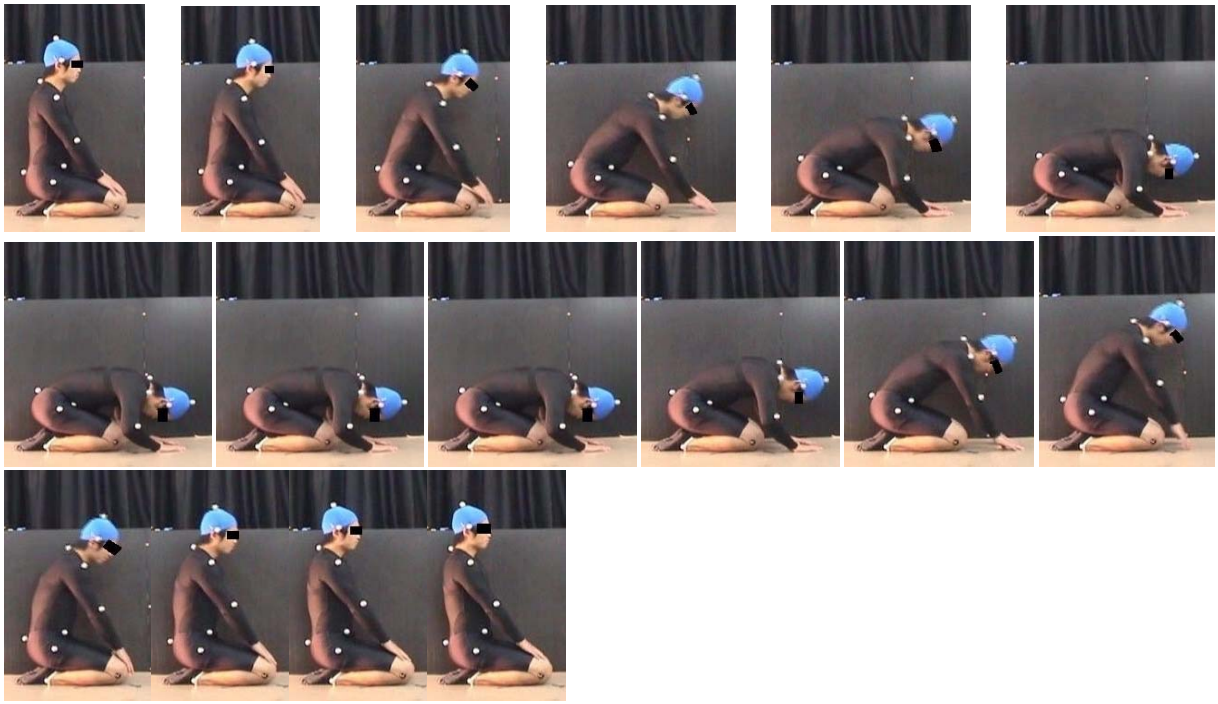

Figure 3: Posture change with sagittal plane of right in ZAREI

RESULTS: Regarding angular degree parameter of RITSUREI, MA made smaller angular degree of the upper limbs and angular degree of the neck than that of AS. In the angular parameter of ZAREI, there was no significant difference (Table1). In time parameter, components of total time of ZAREI, from beginning of it to stopping, from stopping of it to end, and from beginning of RITSUREI to stopping were significantly shorter than that of AS (Table2). In all components, average moving backward distance (±) at standing:12.9 ±3.9cm by AS, 12.1 ±3.3cm by MA. There was no significant difference between AS and MA in this parameter.

Table 1: Average amount and standard deviation of angular degree parameter in AS and MA

	AS(n=18)		MA(n=15)	
	mean	S.D.	mean	S.D.
ZAREI				
Maximum angular degree of upper limb(deg)	84.4	6.6	83.8	8.7
Maximum angular degree of neck(deg)	35.0	10.2	30.0	15.3
RITSUREI				
Maximum angular degree of upper limb(deg)	60.0	11.1	45.3 *	12.6
Maximum angular degree of neck(deg)	21.6	11.7	12.9 *	11.3

Table 2: Average amount and standard deviation of time parameter in AS and MA

	AS(n=18)		MA(n=15)	
	mean	S.D.	mean	S.D.
ZAREI				
Total (s)	4.89	0.86	3.96*	0.49
Biginning – Stopping (s)	1.80	0.44	1.28*	0.14
Stopping (s)	1.16	0.46	0.96	0.28
Stopping – End (s)	1.95	0.32	1.72*	0.20
RITSUREI				
Total (s)	3.55	0.82	3.04	0.66
Biginning – Stopping (s)	1.21	0.41	0.84*	0.34
Stopping (s)	0.95	0.35	0.93	0.22
Stopping – End (s)	1.38	0.32	1.27	0.29

DISCUSSION AND CONCLUSIONS: Regarding angular degree parameter, it is important to keep flexion from 15 degree to 30 degree, to keep direction of eyes constant, not to flex only head, and not to flex too much (edo et al., 1985. son, 1987). In this study, average maximum angular degree of loin conducted by MA was bigger than that of one shown in text. However, this typical characteristic of bow in BUDO made their flexion lower than that of NS. It is said that NS tended to make deeper-flexion when they bow (Morishita et al., 1985). This is one kind of reason that there was significant difference.

In the time parameter, how long bow was conducted by MA was obviously shorter than that of NS. This is because MA provided for bow sooner compare for NS. In business rule, it is one way to provide for bow sooner. This is because this way is easier to show one's feeling of appreciation, respect and deference. That is reason why BUDO bow is regarded as practical bow even in social rule when bow teaching is conducted.

In displacement parameter, it is regarded as better to keep our mode of behavior natural in BUDO rule. This is reason why it is thought that bow conducted by MA tended to make low angular degree. However, this hypothesis was not established because there was no significant difference in two groups. From medical perspective, BUDO bow is less stressful for loins than that of conducted by NS, and it is expected that that kind of bow is suitable for person who have prior history of back pain.

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