Comparison of physical fatigue by holding Compact shoulder camcorder and handheld camcorder

Experiment report

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Contents

Chapter 1 Purpose and method of experiment

1. Purpose

Evaluates the difference of physical fatigue when shooting by compact shoulder camcorder and handheld camcorder

2. Method

Experiments the operation by users in terms of “The research about the operability of professional camcorder”. For this purpose, evaluates the physical fatigue from the psychological, physiological and behavioral point of view.

Chapter 2 Outline of experiment

1. Schedule

February 13th(Tue) and 14th(Wed), 2007

2. Place

Laboratory in Research Institute of Human Engineering for Quality Life

Chart 1:Laboratory

3. Testees

Two right handed men without lumbago and stiffness of shoulder

Table 1 Attribute of candidate of testee

Percentile value of candidate	Age	Height (cm)	Weight (kg)	Number
25 to 75 percentile	20 to 39	166 to 174	59 to 71	2

Calculated from “HQL Anthropometric Reference Data Base 1992-1994”

4. Camcorders

Table2 Camcorder

Type	Compact shoulder	Handheld
Dimensions (mm)	235(W)×232(H)×438.5(D)	163(W)×194(H)×365(D)
Mass (kg)	3.3	2.4

5. Procedure

Time table

Table3 Time table

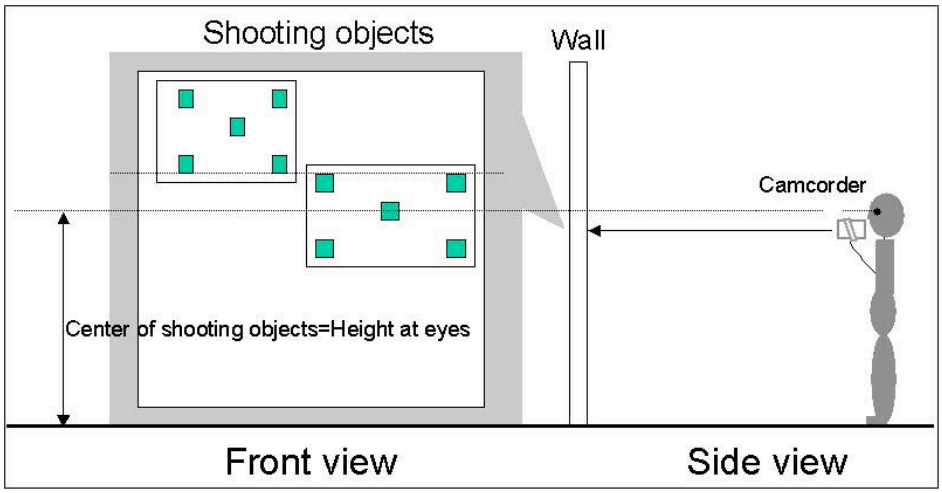
	Description		Min.	Elapsed Min.	Note
1	Reception		1	1	
2	Explanation of experiment and confirmation of a letter of acceptance		2	3	
3	Confirmation of physical condition		2	5	
4	Confirmation of questionnaire of daily life		2	7	
5	Change cloths		3	10	
6	Measurement of general attributes		5	15	
7	Attachment of sensor		5	20	Electrocardiogram sensor
8	Shooting by the first camcorder	Explanation how to hold and subjective evaluation of physical fatigue	2	22	
9		10 minutes rest	10	32	
10		Shooting	10	42	1. Shoot front object 30 seconds 2. Shoot left object 30 seconds 3. Shoot front object 9 minutes
11	20 minutes rest		20	62	Includes 2 min. to answer to questionnaire
12	Shooting by the second camcorder	Explanation how to hold and subjective evaluation of physical fatigue	2	64	
13		10 minutes rest	10	74	
14		Shooting	10	84	1. Shoot front object 30 seconds 2. Shoot left object 30 seconds 3. Shoot front object 9 minutes
19	Answer to questionnaire		2	86	
20	Remove sensor		4	90	Electrocardiogram sensor
21	Answer to general evaluation questionnaire		4	94	
22	Measure grasping power and strength in his back		3	97	Twice each
23	Change cloths		5	102	
24	Confirmation of physical condition		1	103	
25	Closing		2	105	
Total 105 min.					

■Note

*Free for standing up or sitting down during the rest

*Explain to shoot objects without moving in advance

*Each testee is allowed to suspend shooting whenever he felt impossible to continue.



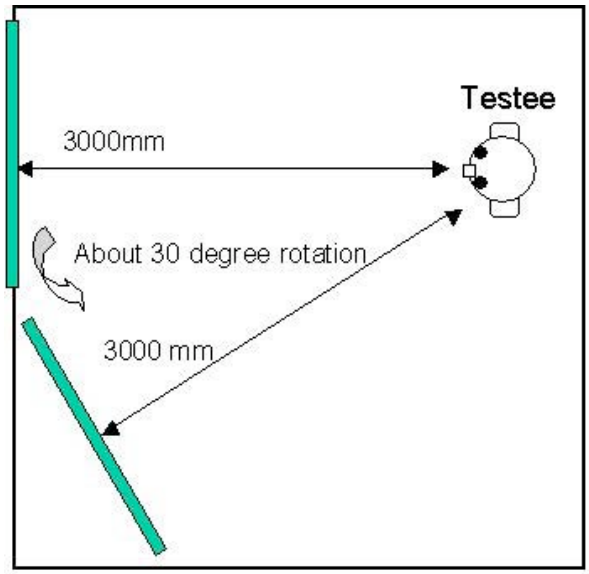


Chart2 Experimental system layout

a) Order of shooting camcorder

Order is switched testee by testee

b) Schedule

Experiment for testee 1 was done at the same hour over two days. Experiment for testee 2 was done in series within a same day. Chart 4 shows the exact schedule.

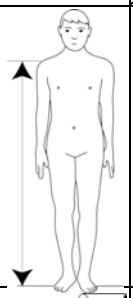
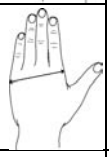
Table 4 Date and order of shooting experiment by testee

	Testee 1		Testee 2	
First	Feb 13th from 15:00	Compact shoulder	Feb 14th from10:00	Handheld
Second	Feb 14th from 15:00	Handheld		Compact shoulder

6. Contents of measurement

(1) Measurement of general attributes

Table 5 Items of measurement of general attributes

	Parts	Definition	Instruments
0	Dominant hand	Self assessment	
1	Height		
3	Weight		
4	Height at shoulder (Standing)	The highest position of collarbone 	Anthporo-meter
5	Length of hand	The straight length from the end of palm to the top of longest finger at palm side 	Sliding caliper
6	Length of palm	The straight length from the end of palm to the end of nearest finger at palm side 	
7	Width of hand	The straight length of palm between the center at radius side and the center at ulna side 	
8	Grasping power		Hand dynamometer
9	Strength in back		Back dynamometer

Measured for right hand only

(2) Psychological measurement

The following Questionnaire was asked about the physical fatigue before and after shooting.

Table6 Psychological measurement items

Timing of questionnaire	Questionnaire	Evaluation
・Before shooting ・After shooting	Fatigue (top right corner half of the body)	3.Feel strongly 2.Feel considerably 1.Feel slightly 0.Don't feel
	Fatigue (whole body)	
	Fatigue by part (Part felt fatigue and level of fatigue) (Refer chart)	

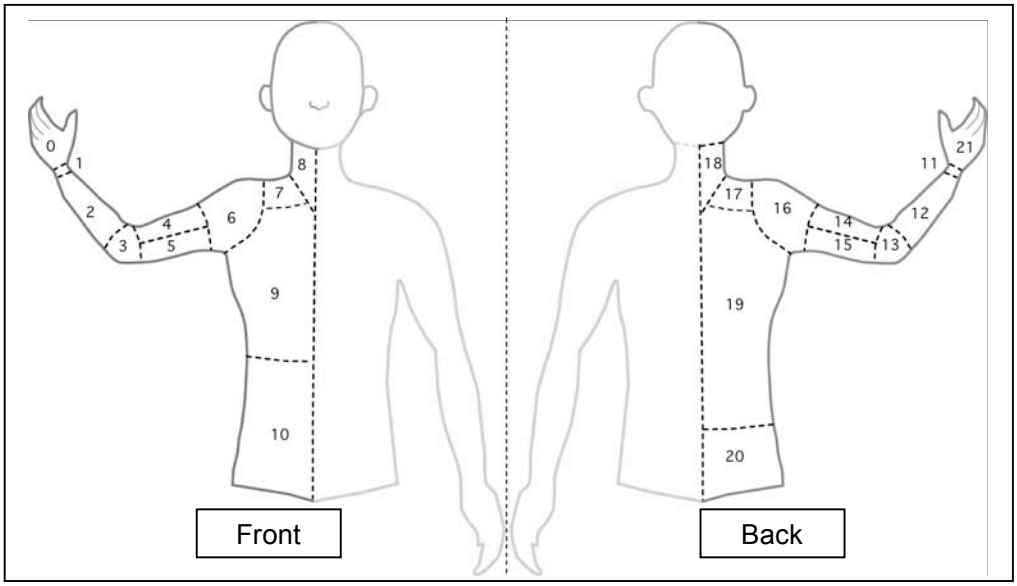


Chart3 Check sheet of the fatigue by part

After shooting both camcorders, each testee were asked to evaluate to feel which camcorders strongly relatively and ranked with its reason.

(3) Physiological measurement

In order to evaluate the fatigue, electrocardiogram was measured from the start of rest to the end of shooting.

(4) Behavioral measurements

・Shot testees to check the blur and their physical status during shooting (video).

・Shot how to hold camcorder by testee (still).。

Chapter 3 Results of measurements

1. Measurement of general attributes

Show the data of general attributes by testee

Table7 Results of measurement of general attributes

	Item	Testee No.1	Testee No.2	Unit
General attributes	Dominant hand	Right	Right	
	Height	1,720	1,775	mm
	Weight	74.5	78.0	kg
	Height at eyes	1,600	1,661	mm
	Height at shoulder	1,411	1,464	mm
	Length of hand	183	197	mm
	Length of palm	105	111	mm
	Width of palm	84	87	mm
	Grasping power	32.2	45.0	kg
	Strength in back	84.9	105.0	kg

2. Continuous time of shooting objects

Table8 Continuous time of shooting objects by testee

Continuous time (sec)	Compact shoulder	Handheld
Testee No1	520	150
Testee No2	600	450

3. Psychological measurements

(1) Feeling of fatigue (top right corner half of the body and whole body)

Evaluation points of the feeling of fatigue on top right corner half of the body and whole body before and after shooting by testee

Table9 Evaluation result of feeling of fatigue by testee No.1

Feeling of fatigue		Type		Points of evaluated fatigue
		Compact shoulder	Handheld	
Top right corner Half of the body	Before shooting	1	1	
	After shooting	3	3	3.Feel strongly
	Difference	2	2	2.Feel considerably
Whole body	Before shooting	0	0	1.Feel slightly
	After shooting	2	3	0.Don't feel
	Difference	2	3	

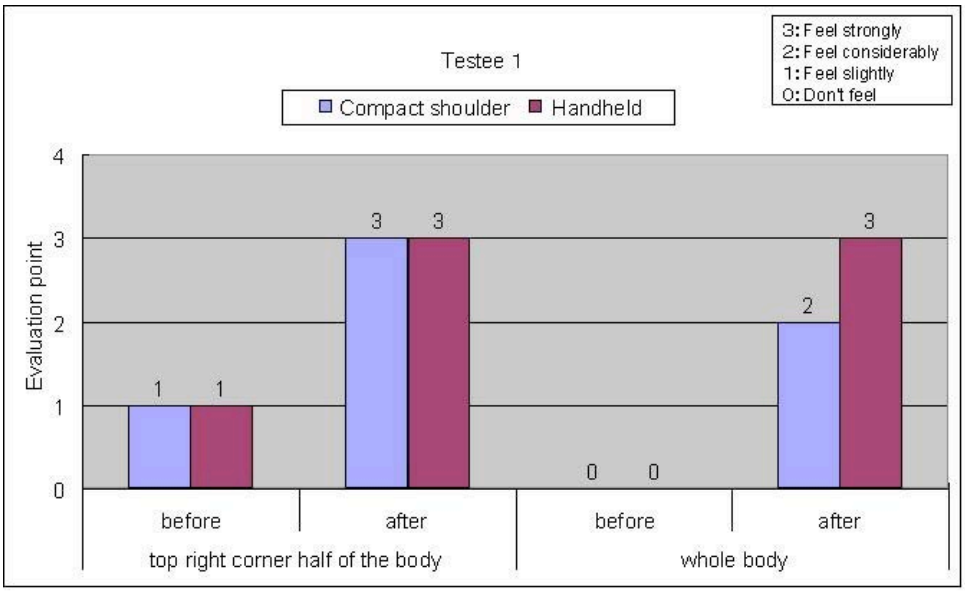


Chart4 Evaluation result of feeling of fatigue by testee No.1

The fatigue before shooting was relatively low in both top right corner half of the body and whole body and no difference between types of camcorder. After shooting, he strongly felt the fatigue for both camcorders in the tope right corner half of the body. But, he felt the fatigue more strongly for the handheld camcorder in the whole body.

From the points before and after shooting point of view, the changed value before and after shooting in the top right corner half of the body was bigger than the whole body. But, the changed value of the whole body for the handheld was bigger than the compact shoulder.

Table10 Evaluation result of feeling of fatigue by testee No.2

Feeling of fatigue		Type		Points of evaluated fatigue
		Compact shoulder	Handheld	
Top right corner Half of the body	Before shooting	1	1	
	After shooting	1	3	3.Feel strongly
	Difference	0	2	2.Feel considerably
Whole body	Before shooting	0	0	1.Feel slightly
	After shooting	0	2	0.Don't feel
	Difference	0	2	

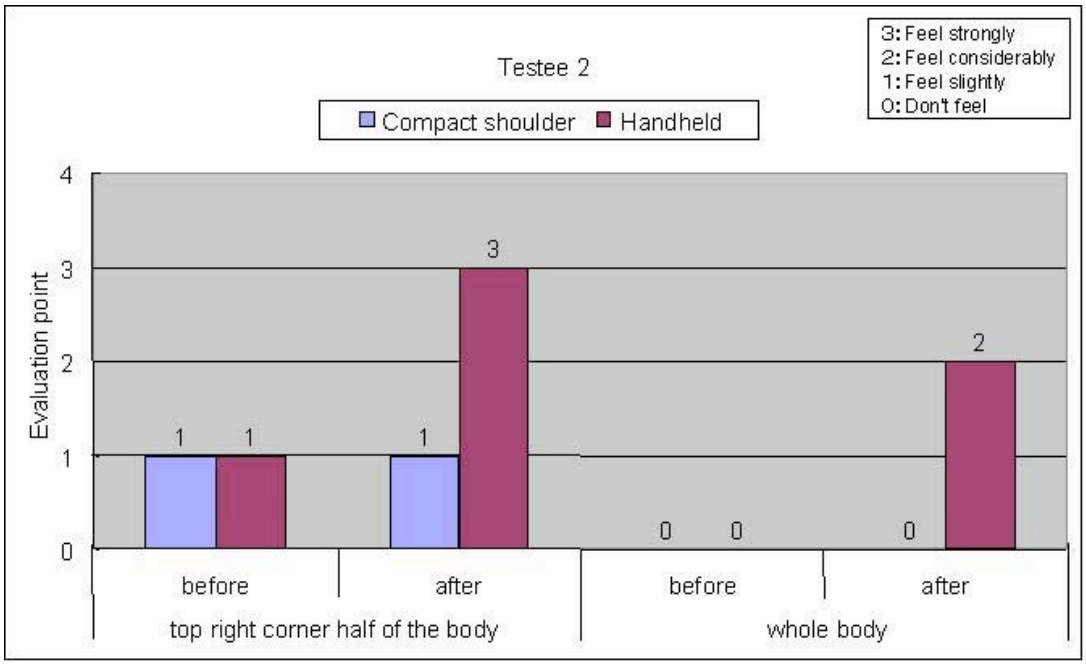


Chart5 Evaluation result of feeling of fatigue by testee No.1

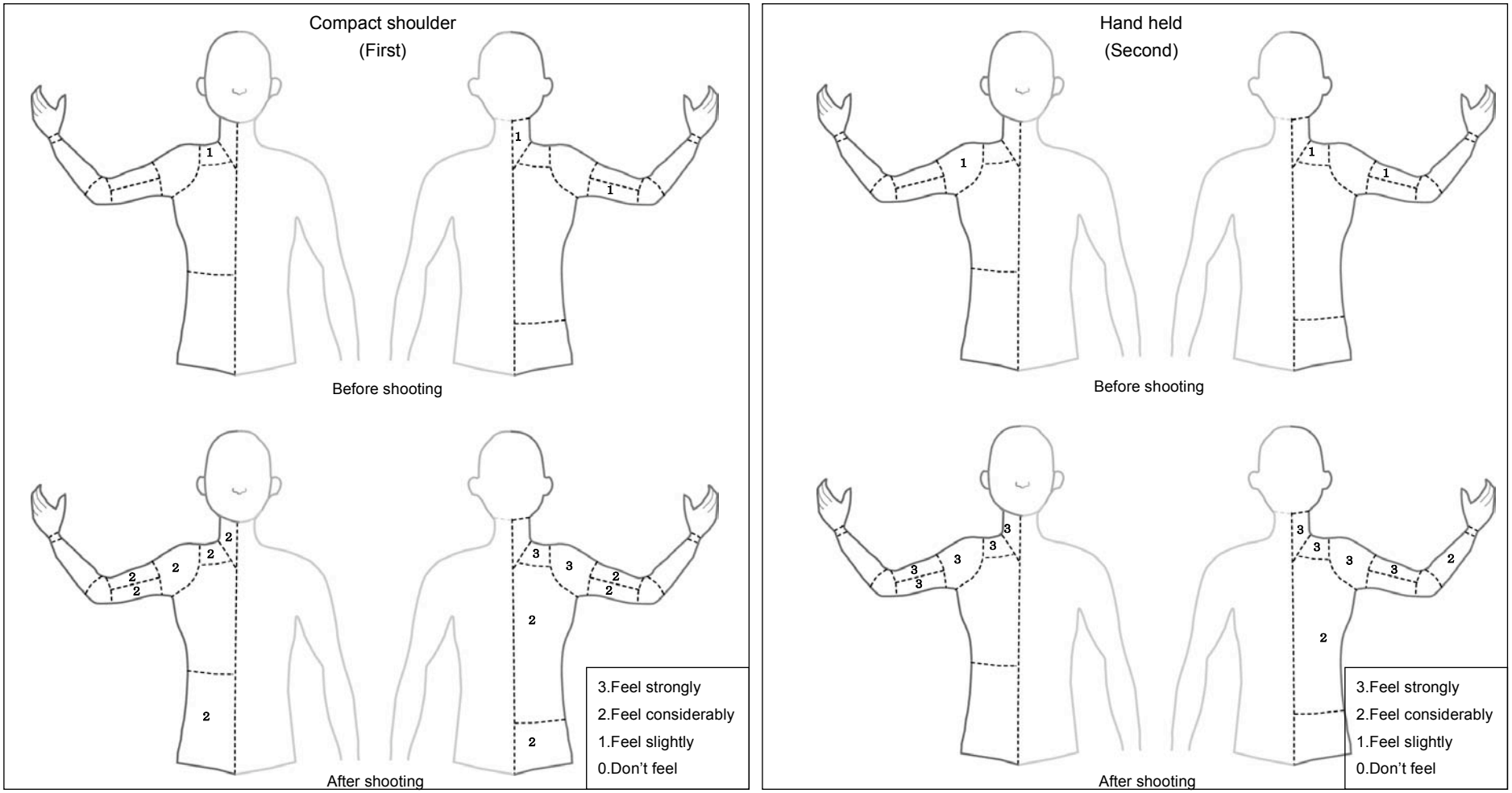
The fatigue before shooting was relatively low in both top right corner half of the body and whole body and no difference between types of camcorder. After shooting, he felt the fatigue in both top right corner half of the body and the whole body more strongly for the handheld rather than compact shoulder.

From the points before and after shooting point of view, the change of fatigue for the compact shoulder was zero, but he felt the fatigue more strongly for the handheld.

(2) Feeling of fatigue by part

Following graphs show the fatigue part by part before and after shooting to check the degree and the range of the parts.

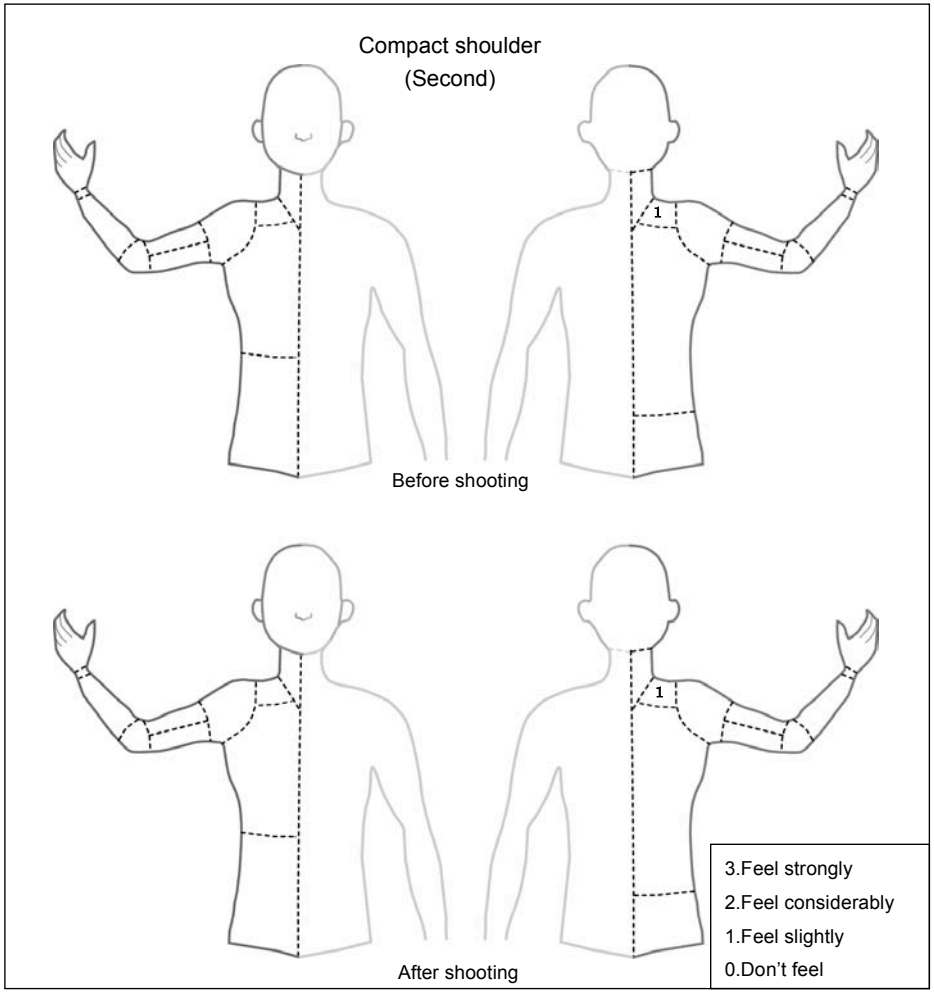
Chart6 Evaluation result of feeling of fatigue by parts by testee No.1

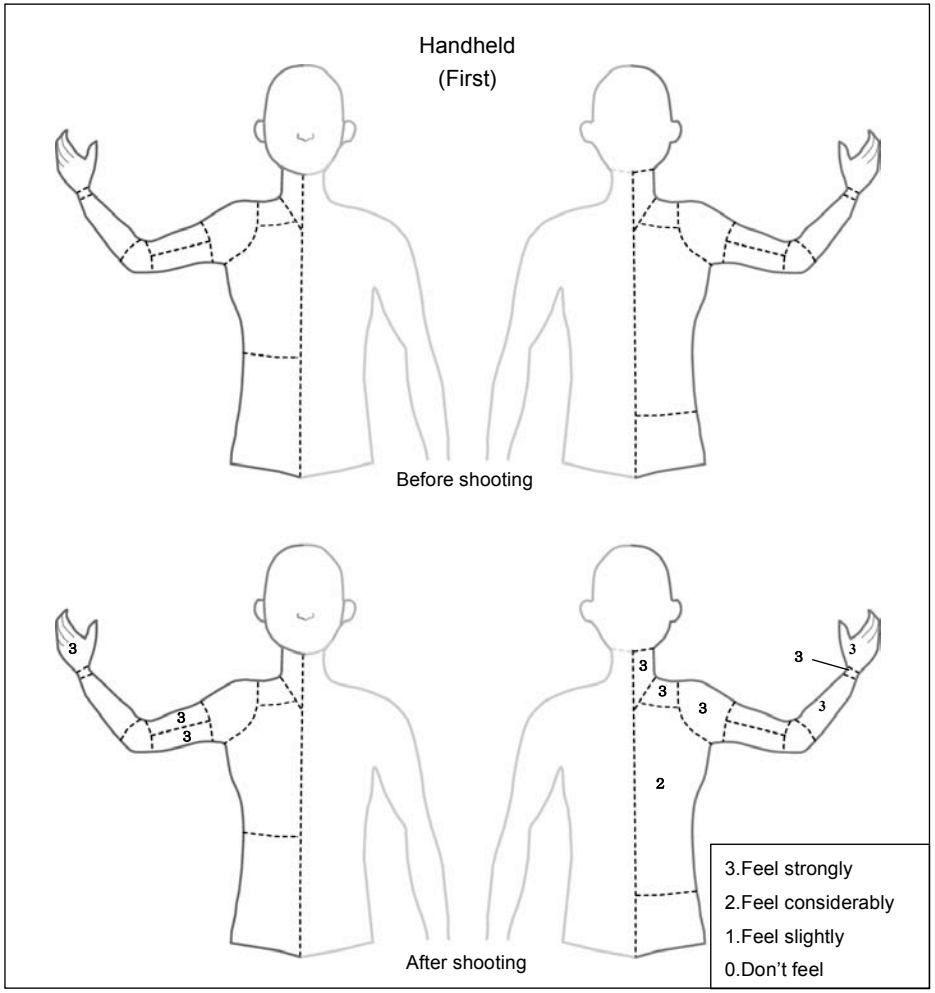


The range of the parts felt fatigue for the compact shoulder spread over the back and waist after shooting. He felt it most strongly on the shoulder and considerably on others.

The range of the parts felt fatigue for the handheld concentrated to the shoulder and upper arm And felt it most strongly on the most of parts. As a result, the range of fatigue for the compact Shoulder is wider, but he did not feel it on the arm so much.

Chart7 Evaluation result of feeling of fatigue by parts by testee No.2





Spread and increase of the parts of fatigue after shooting the compact shoulder were none.
The range of the parts felt fatigue for the handheld concentrated to the shoulder and upper/lower Arm and felt strongly. As a result, he felt less fatigue for the compact shoulder.

(3) Overall comments about fatigue by testee

Followings are the reply of each testee about the question of which camcorder you felt more fatigue.

Table11 Comments of feeling of fatigue by camcorder by testee No.1

Type of camcorder felt the fatigue more strongly		
Order	Type	Comments
First	Handheld	Cannot afford to hold by one hand.
		Cannot easily focus objects due to its heaviness.
Second	Compact shoulder	Since it can be supported by shoulder, could keep holding for a long time.
		Could easily focus.
		Could hold stably.

Table12 Comments of feeling of fatigue by camcorder by testee No.2

Type of camcorder felt the fatigue more strongly		
Order	Type	Comments
First	Handheld	Too heavy.
		Cannot afford to hold by one hand.
Second	Compact shoulder	Can disperse the weight to both head and shoulder.
		Since the shape of finder is fit, can see the picture more clearly.

4. Physiological measurements

R-R interval variation

During the rest and shooting, R-R interval value was extracted from the electrocardiogram sensor. When the average value during the rest is “1”, the ratio during shooting against it is shown below.

Note

1. R-R interval means the duration between R waves.
2. Generally, the lower value of R-R interval shows more fatigue.

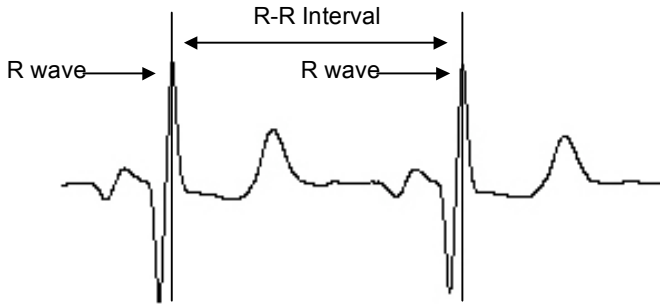
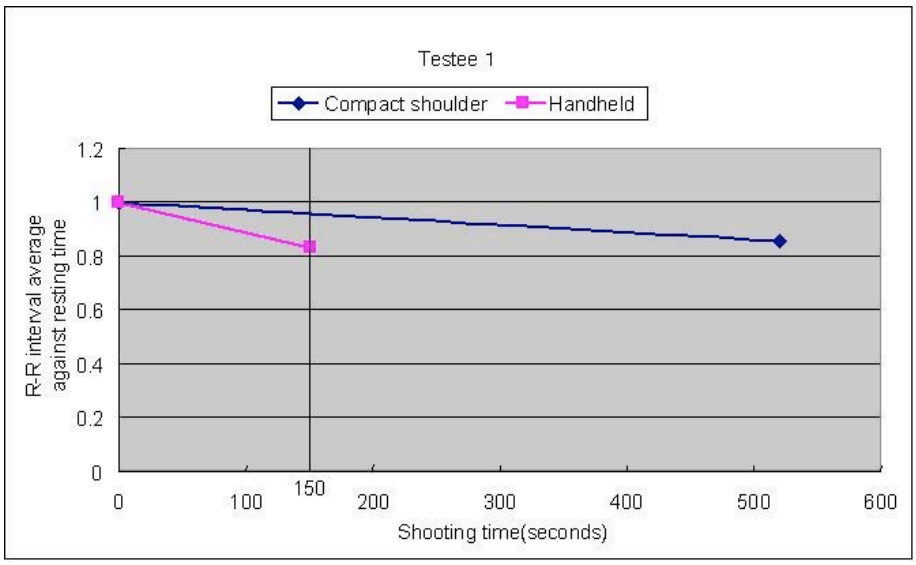


Chart8 Change of R-R interval by camcorder of testee No.1

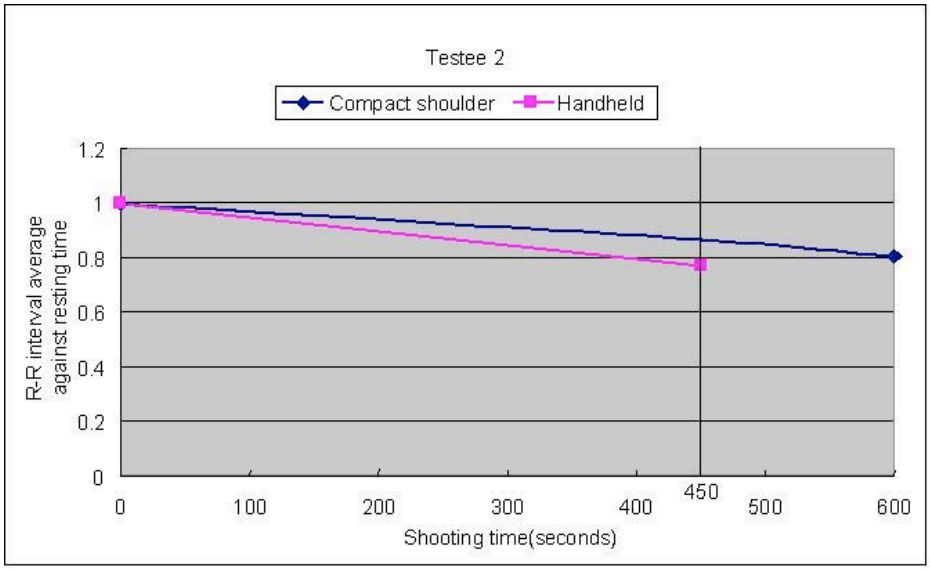


	Continuous shooting time (sec)	Value at 150 sec. if it is "1" at resting time
Compact shoulder	520	0.96
Handheld	150	0.83

Table13 Continuous shooting time and R-R interval comparison by testee No.1

At the point of 150 sec. after starting shooting, the ratio of the handheld was 0.13 lower.

Chart9 Change of R-R interval by camcorder of testee No.2



	Continuous shooting time (sec)	Value at 450 sec. if it is "1" at resting time
Compact shoulder	600	0.87
Handheld	450	0.77

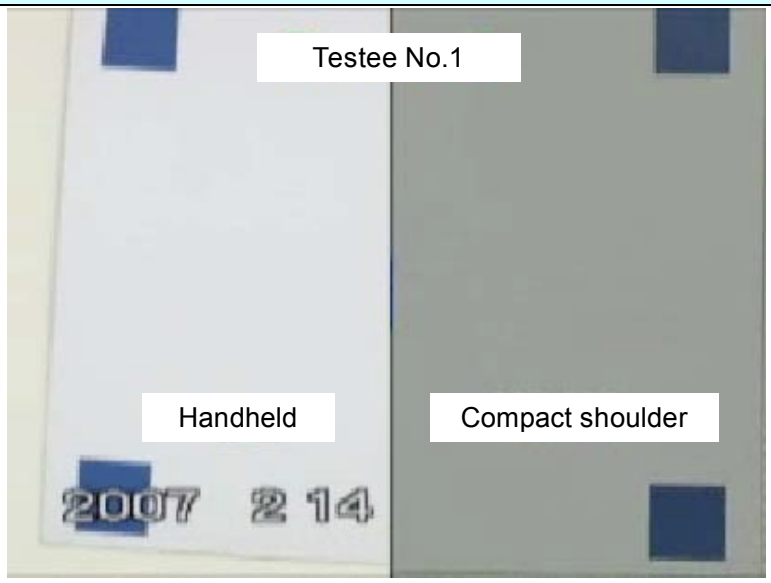
Table14 Continuous shooting time and R-R interval comparison by testee No.2

At the point of 450 sec. after starting shooting, the ratio of the handheld was 0.1 lower.

5. Behavioral measurements

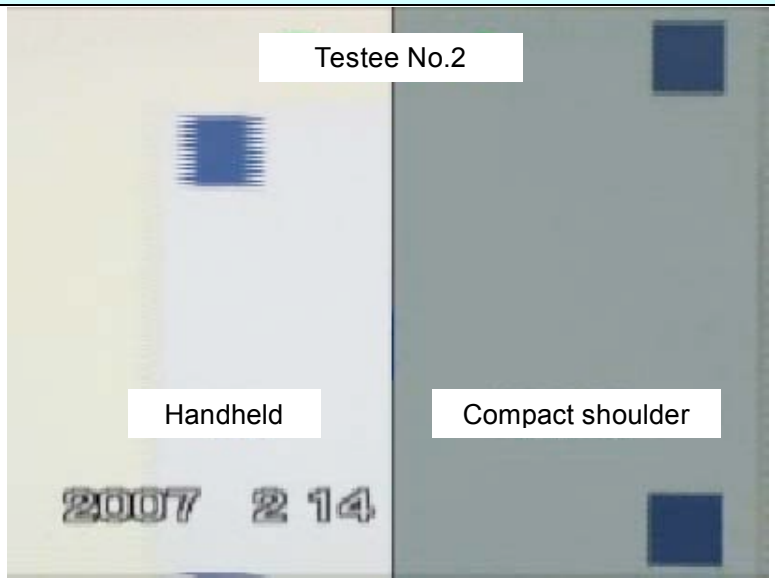
Following charts show the still comparison pictures extracted from the moving pictures shot by each camcorders from 50 seconds before the end to the end to check the degree of the blur.

Table15 Comparison of picture shot by testee No.1

Testee No.1	
Most blurred picture	
Degree of blur	Compact shoulder<Handheld
Speed of blur	

By comparing the most blurred pictures between the compact shoulder and the handheld, the picture shot by the handheld was more blurred. By comparing the pictures in 50 seconds between the compact shoulder and the handheld, the blur shot by the handheld was faster and more frequent.

Table16 Comparison of picture shot by testee No.2

Testee No.2	
Most blurred picture	
Degree of blur	Compact shoulder<Handheld
Speed of blur	

By comparing the most blurred pictures between the compact shoulder and the handheld, the picture shot by the handheld was more blurred. By comparing the pictures in 50 seconds between the compact shoulder and the handheld, the blur shot by the handheld was faster and more frequent

Chapter 4 Conclusions

In order to evaluate the physical fatigue in shooting by the difference of type of camcorders, two different type of camcorders were practically shot by testees to evaluate it from the psychological, physiological and behavioral points of view.

In spite of small number of testee, the compact shoulder provided less fatigue feeling from the psychological measurement. And, the compact shoulder provided less physical stress from the physiological point of view. Moreover, the blur of pictures shot by the compact shoulder was less, smaller and slower.

Finally, the physical fatigue of the compact shoulder was less than that of the handheld.

Table17 Summary

Measurement items			Fatigue	
			Less	More
Psychological measurement	Fatigue	Top right corner half and whole body	Compact shoulder	Handheld
		By part	Compact shoulder	Handheld
Physiological measurement	R-R interval		Compact shoulder	Handheld
Behavioral measurement	Degree of blur		Compact shoulder	Handheld
	Speed of blur		Compact shoulder	Handheld