

# EFFECT ON BRAIN ACTIVITY OF CLOTHING PRESSURE BY WAIST BELTS –Effect of Visual Information and Sexual Specificity of Brain Activity–

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**Abstract :** The purpose of our study is to clarify about the influence that the visual information gives to the brain activities when pressure exerted the abdomen by waist belts. The visual information means that the some different visual information is inputted it, and the brain activity is evaluated by Electroencephalogram(EEG) measurements. At the same time, we carried out the sensory tests and verified about the relations between the psychological stress and the brain activities. There was a difference in change in the power of the  $\alpha$  wave with the eyes opened between man and woman. From the result of the sensory test, in the case of under the condition in the darkness with the eyes opened, there was no change in the  $\alpha$  wave with before the pressure and after the pressure. In the other cases,  $\alpha$  wave changed in the same way with before the pressure and after the pressure. In the case of the visible and the invisible in pressure place,  $\alpha$  wave changed in the same way with before the pressure and after the pressure, but there was a difference in value. From the above, it isn't recognized that the visual information is influencing a pressure sense but some influences are given to it to the brain activities.

**Keywords:** *Electroencephalogram, Clothing pressure,  $\alpha$  wave, Sexual specificity, Clothing comfort*

## 1. Introduction

The clothing comfort can be divided roughly into psychological and physiological clothing comfort. Clothing pressure is a factor of physiological clothing comfort, it is reported abundantly that the influence of the oppression on the peripheral nervous system such as heart rate and blood flow, etc.[1] and the central nervous system based on measuring EEG[2]. However, most of this study are carried out in closed eyes condition. EEG measurement in open eyes condition is very important because visual information occupies most of the information which a human being gets in daily life. The purpose of our study is to clarify the influence of the oppression giving to brain activity, when the several kinds of visual information was inputted it. We adopted the way of abdomen oppression by waist belt on the assumption of daily life. We measure EEG as the index of brain activity. Simultaneously, the sensory test(ST) is also carried out, and we verified the relationship between the psychological response and brain activity.

The content of brain activity can not be clarified from EEG, but it reflects the activity level of brain

from arousal to sleep. Therefore, EEG is effective as an index of the activity level of brain.

## 2. Experiment

In this study, we adopted the way of the abdomen oppression by waist belt on the assumption of daily life. The condition of oppression is to constrict at 90% of the examinee's girth size using 4[cm] wide non-elastic belt. In the above oppressive condition, we clarified the influence of the oppressive stimulation to brain activity when the several kinds of visual information was inputted it. The relationship between relaxing condition (equal to clothing condition) and visual information was reserched by  $\alpha$  waves. Simultaneously, sensory test is also carried out.

The conditions for visual information are

1. Closed eyes condition
2. Open eyes condition in darkness
3. Tightened waist-belt is visible.  
A mirror was put before the subject, visual information is reflected from thorax to leg.

4. Tightened waist-belt is invisible.  
 The oppressive place was covered with the cloth.  
 This means visual information was limited.

The examinees are healthy college students 9 female and 9 male. The temperature in experiment room is 25 °C with 60% relative humidity. The examinees were seated in chairs, wearing short sleeve T-shirts and shorts on underwear. Measurement of EEG and sensory test were carried out in accordance with the schedule shown in Fig.1. In the sensory test, the examinees evaluated sensations of tightness, arousal and comfortable feelings on each condition by numerical grades from 0 to 10. And the rest between measuring conditions was 5 minutes.

Pressure	Before	→	Under	→	After
Sensory test	S T	→	S T	→	S T
EEG	2min.	→	2min.	→	2min.

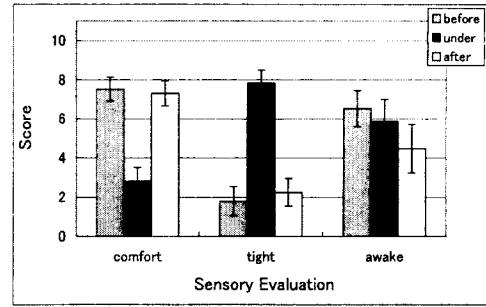
Figure 1: Measurement order

Measurement place is Fz, Cz and Pz based on the 10-20 electrode system. EEG was analyzed by the power spectrum. The frequency bandwidth of  $\alpha$  waves are 8~13[Hz]. Up to now, much research has been carried out to evaluate brain activity via EEG measurement. As a result of this research, it has been clarified that brain activity conditions can be evaluated through alpha waves.

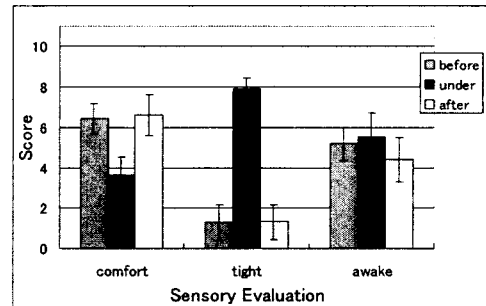
Alpha waves appear best in rest conditions with closed eyes. In conditions of excitement and thinking, alpha waves are suppressed. From this it seems that alpha waves increase under conditions of low brain activity and decrease under conditions of high brain activity. Therefore, in this study, the change of alpha waves in accordance with pressure exerted by clothing was examined, and the change in the condition of brain activity as a result of this pressure was estimated.

The EEG's were analyzed by means of power spectrum analysis. First, 14 data groupings for the obtained EEG data for each unit, which was divided into 8 second intervals. The power spectrum of the data divided into 14 groupings with a fast Fourier transform (FFT) with a humming window. The power spectrum, which in the end was an average of the sum of the 14 power spectrum groupings, was obtained. It was not possible to compare the power spectra of alpha waves between examinees without processing data, since individual differences were usually too great for alpha waves. In this study, the power spectrum of alpha waves was standardized as follows. The standardized power of alpha waves is given by

$$P_{\alpha} = P_{\alpha}^{(i)} / P_{\alpha}^r \quad (1)$$

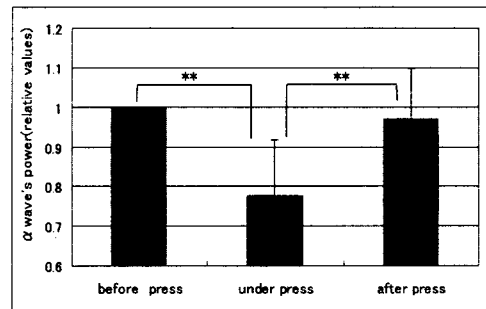


(a) Female

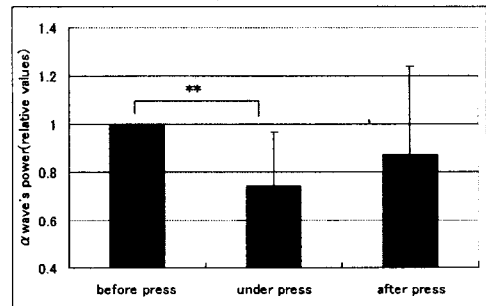


(b) Male

Figure 2: Result of sensory test

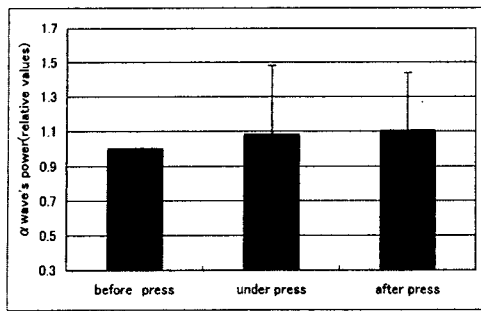


(a) Female

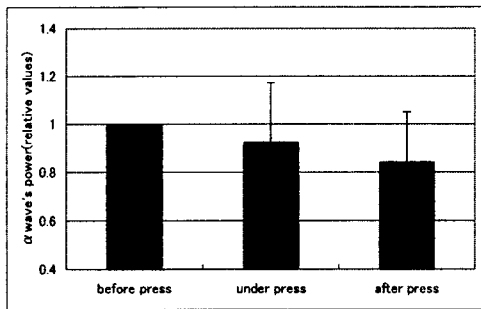


(b) Male

Figure 3: Measured alpha power with closed eyes

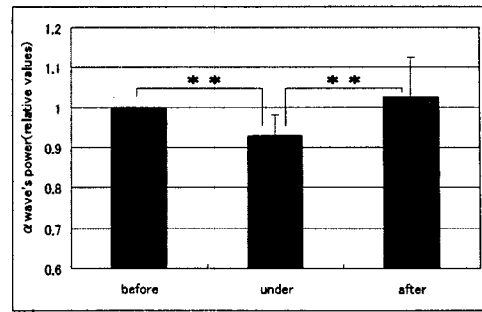


(a) Female

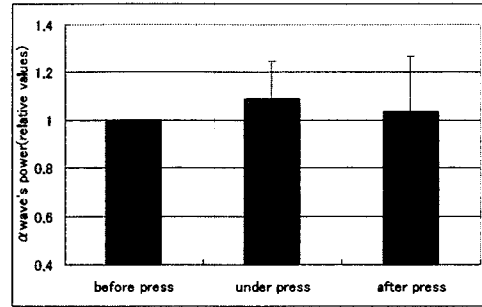


(b) Male

Figure 4: Measured alpha power under open eyes condition in darkness

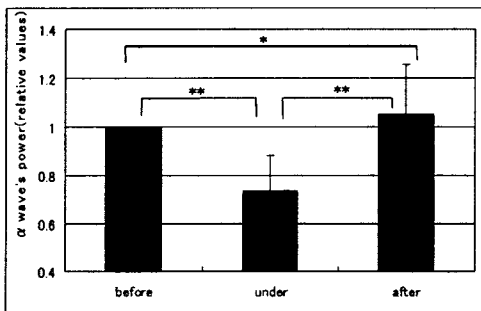


(a) Female

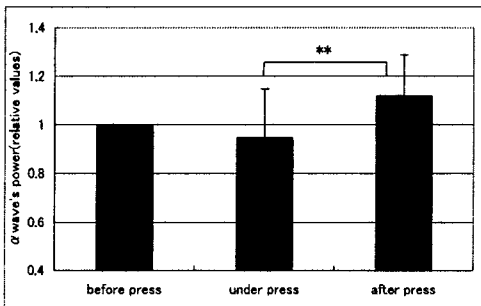


(b) Male

Figure 6: Measured alpha power under invisible of tightened waist-belt



(a) Female



(b) Male

Figure 5: Measured alpha power under visible of tightened waist-belt

where  $P_{\alpha}^{(t)}$  shows the sum of power spectra in the bandwidth of alpha waves for each experimental condition.  $P_{\alpha}^r$  shows the sum of power spectra in the bandwidth of alpha waves under the rest condition. The analysis was separately carried out for open eyes and closed eyes states, since the psychosomatic states are greatly different.

### 3. Results

#### 3.1. Sensory test

Mental conditions of female and male subjects are shown in Fig.2. The subjects felt discomfort and tight sensation under oppression in comparison with before and after pressure. We obtained the same results for each sensation. But there was no relevance with oppressive condition for arousal sensation. Significant difference was recognized only oppressive condition.

#### 3.2. $\alpha$ waves power

##### 3.2.1. EEG under closed eyes condition

As for oppressive condition, mean value of the intensity of  $\alpha$  waves shown in Fig.3. The mark \*\* in the table means that there is significant difference at 1% level of significance, in the same way, the mark \* means 5% level of significance. The intensity of  $\alpha$  waves decreased under oppression. Significant difference was recognized only oppressive condition.

### 3.3. EEG under open eyes condition in darkness

From Fig.4, the intensity of  $\alpha$  waves did not change for each oppressive condition. From the result of questionnaire, the answer of "Incongruity is sensed" was got. This result indicates the effect on the brain activity of the condition that what is not seen in the darkness.

### 3.4. EEG under visible of tightened waist-belt

Mean value of the intensity of  $\alpha$  waves for female shown in Fig.5(a). Mean value of the intensity of  $\alpha$  waves for male shown in Fig.5(b). The mark \*\* in the table means that there is significant difference at 1% level of significance. In the result of female, the intensity of  $\alpha$  waves decreased under pressure. Significant difference was recognized only oppressive condition. In the result of male, the intensity of  $\alpha$  waves increased the interval between under and after oppression. Significant difference was recognized only oppressive condition.

### 3.5. EEG under invisible of tightened waist-belt

Mean value of the intensity of  $\alpha$  waves under invisible of tightened waist-belt shown in Fig.6. Fig.6(a) is shown into the result of female, and Fig.6(b) is shown into the result of male. The mark \*\* in the table means that there is significant difference at 1% level of significance. The intensity of  $\alpha$  waves decreased under pressure. There was significant difference for alpha power between pressure to abdomen and non-pressure. Especially, in females result, there was significant difference between three pressure conditions. Significant difference was recognized only oppressive condition.

### 3.6. Difference of sexual specificity

The results of analysis of variance are shown in Table1. It was analyzed about 3 factors visual information, oppressive condition and sexual specificity. The mark \*\* in the table means that there is significant difference at 1% level of significance, in the same way, the mark \* means 5% level of significance. Significant difference was recognized visual information, oppressive condition and the interaction between visual information and sexual specificity. When sex was different, brain activities were different, too.

## 4. Conclusions

The purpose of our study is to clarify the influence of the oppression giving to brain activity, when the several kinds of visual information was inputted it. We adopted the way of the abdomen oppression by waist belt on the assumption of daily life. We measure Electroencephalogram(EEG) as the index of brain activity. Simultaneously, the sensory test(ST) is also carried out, and we verified the relationship between the psychological reaction and brain activity.

Table 1: Analysis of variance about sexual difference

Factor	S	f	V	F
A (vision)	0.30	3.00	0.10	3.39*
B (press)	0.60	2.00	0.30	10.01**
C (sex)	0.01	1.00	0.01	0.22
A × B	0.33	6.00	0.06	1.87
A × C	0.27	3.00	0.09	3.03*
B × C	0.14	2.00	0.07	2.41
A × B × C	0.14	6.00	0.02	0.80
E	5.00	168.000	0.03	
Total	6.80	191.000		

1. There is the sexual specificity in the effect on brain activity of the clothing pressure by the waist-belt.
2. In sensory test, the both examinees felt discomfort and tight sensation under oppression in comparison with before and after oppression. On the other hand, from EEG, the change of intensity of  $\alpha$  waves was different between female and male.
3. The change of the intensity of  $\alpha$  waves in visible case was larger than in invisible case. On the other hand, in sensory test, the difference of visual information did not affected it.
4. The influence of visual information is difficult to be perceived because visual information is not somatic somatic stimulation. However, it affected brain activity as unconscious oppressive stimulation.

## References

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