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Development of Elderly Women's Dress Form According to Their Somatotypes for the Silver Apparel Industry+

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Abstract

The purpose of this study is to develop a dress form for elderly women according to their somatotype to be used for improving the fit of garments and patterns. Analyzing each somatotype, there was a significant difference among the 4 somatotypes in most of measure items. Bend-forward Group had shorter front length items. Abdomen-fat Group had lower upper-body values than Average Group and similar lower-body values to Fat Group. In most items except height, Fat Group had the biggest values. Analyzing the mean cross-section according to the section measurement parts, no difference existed in shoulder part and under bust part. However, in upper bust, bust, waist, abdomen, high hip, and hip parts, a significant difference existed. Also, according to the results of the mean cross-section as well as the average cross overlap section for each somatotype, there was a significant difference among the four somatotypes. Thus, Abdomen-fat Group and Fat Group were similar, while Bend-forward Group and Average Group were alike. According to the increase of age, lower body tended to have more conspicuous changes. Analyzing the profile of somatotypes, there existed a obvious significant difference among the 4 somatotypes, implying that the characteristics of somatotype need to be reflected when to develop dress forms for elderly women. Therefore, these differences must be an essential factor in pattern design. Comparing the current dress form with the dress form developed with simulation, we could find that a dress form developed for elderly women which reflects the characteristics of body shape is much better than a dress form developed by simple size variation such as small, medium and large size divisions to improve the fit of garments and pattern designs.

Key words: elderly women's somatotypes, cross-section measurement, bend-forward group, abdomen-fat group, fat group, average group

I. Introduction

Modern society shows the increase of average life span thanks to medical development and cultural-level improvement. Another main characteristic is the lowering rate of birth along with the increasing ratio of the elderly.

Sociologically speaking, it is an aging society when the population over 60 in age amounts to 7%. An aged society begins when the ratio reaches 14%, and a super-aged society starts when it passes 21%. Korea entered into an aging

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society in 2002 by recording 7.1% (Korea National Statistical Office, 2002).

As a result, the increasing number of senior citizens in Korea has brought about some changes in general aspects of clothing, food, and housing. The products are profuse, aiming at the market of silver population.

In Korea, the period of the aged begins at 60 after the 60th birthday or hoegap. Around 70, it is divided into the first half and the second half. Among the chief characteristics of the old are bending waist, shrinking height, thicker waist, increasing hip girth, rounder shoulders, and extended breasts (Kim et al., 2001).

Also, lower body gets thinner in general. Elderly women, compared with elderly men, tend to have diverse somatotype changes. As these physical changes coming from the increase of age have a major influence on clothing fitness and appearance, correct body measurement is a must.

For precise human body measurement of the elderly, brassiere wearing is desirable for body type adjustment (Seong & Kim, 2001). Elderly women are usually divided into 3 or 4 body types through factor analysis, cluster analysis, and discriminant analysis.

3 somatotypes are normal, bent, and extended (Kim & Choi, 2004). 4 somatotypes include normal, stooped, bent, and fat (Choi & Nam, 1995; Nam & Choi, 1997; Yu, 2000; Shin & Lee, 2001; Kim, 2002).

For the standard design of old women's ready-made clothes, the Korea Standard Association made 'Garment sizing systems for elderly women's-KS K 0055'. Lee et al. (2003, 2004a, 2004b) made some research in the establishment of standard somatotype sizes.

In the apparel industry, however, these data are hard to utilize. First-dimension data alone are impossible for correct patternmaking. That's why this study aims to develop dress forms suitable to standard sizes.

The concrete purposes of this paper are as follows:

1. Select the subjects based on 4 somatotypes (average, bend-forward, abdomen-fat, and fat) and analyze somatotype differences through 1-D direct measurement.

2. Analyze somatotype differences through 3-D cross-section analysis by way of the 3-D scanner.

3. Compare and analyze each body type's mean profile and mean cross-section.

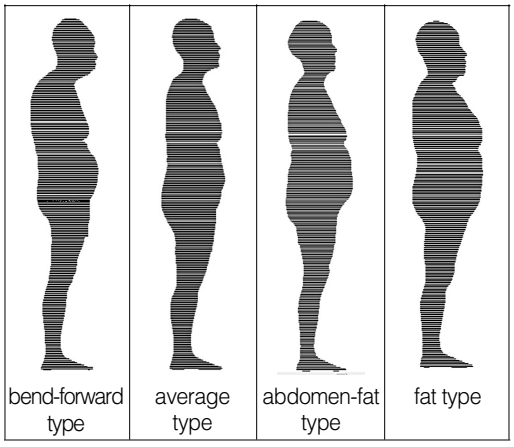
4. Develop elderly women's dress forms by body types through the simulation methods of the Narcis PB (Parametric Body) Model System, and propose the problems of the existing dress forms as basic data for developing patternmaking dress forms.

II. Research Methods

1. Subjects and Classification of Somatotypes

Among the elderly women in their 70s who show typical physical characteristics, subjects were chosen by purposive sampling. The four body types (average, bend-forward, abdomen-fat, and fat) are seen in <Fig. 1>. The classification of somatotype was established by preceding researches (Choi & Nam, 1995; Nam & Choi, 1997; Yu, 2000; Shin & Lee, 2001; Kim, 2002)and a lateral view of subjects.

Bend-forward Group had shorter front length items. Abdomen-fat Group had lower upper-body values than Average Group and similar lower-body values to Fat Group. In most items except height, Fat Group had the biggest values. The mean somatotype subjects were 6, and the other somatotypes were each 3. These 15 subjects



<Fig. 1> Classification of Somatotypes

were selected based on the KS K 0055 (2002) and the *Report of Body Measurement for Elderly Women* (Korean Agency for Technology and Standards, 2002). Compared with the KS K 0055 (2002), Fat Group belonged to the type EH (small hip girth compared with bust girth).

2. Human Body Measurement & Scanning

1) 1-D Direct Measurement

For each subject, Martin-type 1-D direct measurement was held from July 29 through 31, 2003. The items were 30 including body height and weight.

2) Scanning

The 3-D Whole Body Scanner (WB4, Cyberware, USA) was utilized. The postures and basic clothing conditions are shown in <Fig. 2>. The upper garment was a top-typed sports bra and the lower one was short pants. In particular, for the exact measurement of the armpits and crotch, arms and legs were a little spread.

3. Analysis of Mean Cross-sections & Mean Overlap Cross-sections by Somatotypes

1) Cross-section Measurement

In this research for the development of dress forms fitting aged women's body types, both 1-D human size analysis and cross-section measurement were given. The scanned data were changed into *.dwg files for the measurement in the Auto CAD program. The measured areas were shoulders, upper bust, bust, under bust, waist, abdomen, high hip and hips.

<Fig. 2> Scanning Postures

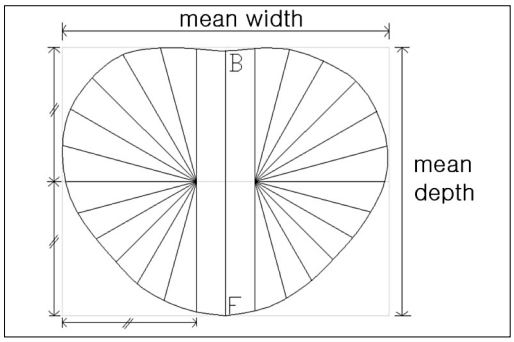
<Fig. 3> shows measurement methods. As shoulders have bigger evenness rate (width/thickness × 100), 1/2 thickness was subtracted from width and divided into 6. Either side was divided by 15˚ and the distance to the surface from left/right center was measured. Upper bust and hips were also divided by 15˚, and the distance to the body surface from left/right center was measured.

2) Each Somatotype's Mean Cross-sections & Mean Overlap Cross-sections

Mean cross-sections were obtained by measuring each part's cross-section values and mean values by body types and measurement areas. Based on waist's mean cross-sections, 1/2 width was regarded as the front/back center line and 1/2 thickness as the side line for overlap cross-sections(Fig 4).

4. Analysis of Mean Profiles by Somatotypes

As in cross-sections, 1/2 line of waist thickness became the base of the side line. Front/back thickness in measurement areas as well as vertical distances between measurement areas were sought. Then, mean profiles were obtained by somatotypes for comparative analysis.



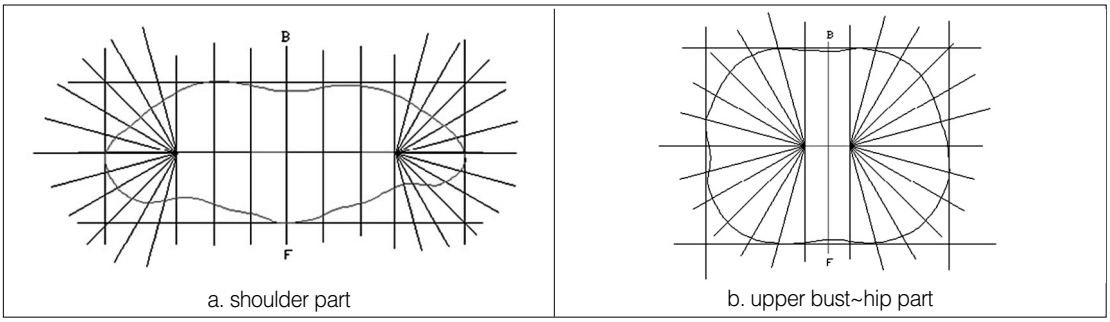
<Fig. 4> Drawing method of mean cross-section

5. Analysis of the Established Elderly Women's Dress Forms & Simulated Dress Forms

At present, dress forms for elderly women only are not for sale in Korea. So, after attaining 3-D simulated dress forms through the Narcis PB (Parametric Body) Model System based on each body type's human sizes and cross-sections, they were compared with aged women's dress forms produced in Japan (TTR, Tokyo).

6. Data Analysis

For statistical analysis, the spss/win (ver 10.1) program was used. The technical statistic analysis, t-test, and ANOVA were held to reveal significance.



<Fig. 3> Cross-section Measurement Methods

III. Results & Discussion

1. Comparison of Human Measurement Results by Somatotypes

<Table 1> shows the comparison results of the measurement in this research and the '*Report of Body Measurement for Elderly Women*' (Korean Agency for Technology and Standards, 2002). The subjects here were divided into Group I (age 70~74) and Group II (age 75~79) for the

<Table 1> Comparison Results of Direct Measurements

(units: cm)

measurement items	group I : 70-74 yrs(KSA 2002)		group II : 75-79 yrs(KSA 2002)		this study (70-79 yrs)		Mollison's relation deviation(σ)a	
	meam	S.D.	meam	S.D.	meam	S.D.	group I	group II
stature	150.1	4.5	148.3	4.7	148.86	5.29	-0.28	0.12
BNP height	128.2	4.3	126.4	4.2	127.71	4.64	-0.11	0.31
FNP height	122.4	4.1	120.7	4.2	122.25	4.86	-0.04	0.37
BP height	102.9	4.4	100.7	4.3	103.73	5.27	0.19	0.70
F.waist height	94.4	3.7	92.9	3.5	94.56	3.86	0.04	0.47
abdomen height	83.8	3.9	83.3	3.3	88.69	3.61	1.25	1.63
hip height	74.2	3.4	74.2	3.3	75.03	3.37	0.24	0.25
crotch height	65.3	3.2	64.9	2.9	65.01	3.31	-0.09	0.04
neck base girth	38.4	1.8	38.4	1.8	36.65	2.45	-0.97	-0.97
bust girth	94.1	6.6	92.7	7.2	95.17	7.27	0.16	0.34
waist girth	83.1	7.0	81.7	7.8	83.99	7.89	0.13	0.29
abdomen girth	94.8	6.5	93.8	7.9	96.57	7.62	0.27	0.35
hip girth	92.5	6.0	91.9	6.8	93.80	7.39	0.22	0.28
CF length	30.5	2.5	30.0	2.8	30.88	3.13	0.15	0.31
SNP to BP length	29.2	2.1	29.1	2.4	30.30	1.74	0.52	0.50
front length	38.3	2.3	37.8	2.6	40.73	3.00	1.06	1.13
back length	36.9	2.3	36.4	2.5	38.83	2.14	0.84	0.97
SP to SP length	36.1	2.0	35.6	2.1	38.93	2.60	1.41	1.59
back interscye length	35.4	2.4	34.6	2.6	36.51	2.97	0.46	0.73
shoulder length	11.6	0.8	11.4	0.8	12.42	0.78	1.03	1.27
shoulder width	33.5	1.5	33.1	1.6	33.87	1.96	0.25	0.48
bust width	29.2	2.3	28.7	2.4	30.59	2.13	0.60	0.79
waist width	27.3	2.0	27.1	2.7	28.74	2.59	0.72	0.61
abdomen width	32.2	1.9	31.6	2.2	33.85	2.23	0.87	1.02
hip width	32.0	1.4	31.9	1.8	33.97	1.92	1.41	1.15
bust depth	25.6	2.2	25.6	2.5	25.48	2.39	-0.05	-0.05
waist depth	23.8	2.5	23.5	2.9	23.86	2.67	0.02	0.12
abdomen depth	26.2	2.6	26.1	3.2	25.83	2.53	-0.14	-0.08
hip depth	24.7	2.9	25.1	3.4	24.36	2.46	-0.12	-0.22
weight	54.7	6.8	52.5	8.1	56.61	6.58	0.28	0.51

comparison by Mollison's relation deviation values.

In height, most items had similar values, but abdomen height was higher in the subjects here. In girth items, a little difference was seen in neckbase, bust, and abdomen, belonging to the average within $\pm 1\sigma$. In length items, this study had slightly bigger measurement values but mostly approaching the mean in width and thickness items.

2. Results of the Comparative Analysis of Mean Overlap Cross-sections by Measurement Areas and Somatotypes

The mean cross-sections in each measurement area were overlapped for comparative analysis, as seen in <Fig. 5>. Significance was hardly noticed in shoulders and under bust, but some significant differences were found in upper bust and bust.

In particular, significance existed in front waist, and somatotype differences became clear in lower body parts. There was significance in back hips. Thus, Abdomen-fat Group and Fat Group were similar, while Bend-forward Group and Average Group were alike. According to the increase of age, lower body tended to have more conspicuous changes. That's why very careful patternmaking is required in the design of lower-body clothes.

<Fig. 6> represents mean overlap cross-sections according to somatotypes. In Bend-forward Group, the order of rear projection is upper bust, bust, under bust, waist, and shoulders. High hip, abdomen, and hip girth are inner than the waist. In the front, abdomen and high hip are protruding. Hips are prominent in the sides, while hip girth is smaller than abdomen girth.

In Abdomen-fat Group, rear projection is in the order of hips, abdomen, and high hip. Front protrusion follows the order of abdomen, high hip, waist, and hips. As bust is a little prominent diagonally, lower body is bigger than upper body.

In Fat Group, the general cross-sections appear to be round. Bust and hips are similar in rear projection, while bust is protruding or similar to Abdomen-fat Group.

In Average Group, rear projection is similar in bust, lower bust, and hips, while front protrusion is alike in bust, abdomen, and high hip. This body type is a well-balanced somatotype in front-back and upper-body/lower-body structure. Thus, these somatotype characteristics should be well reflected in the patternmaking of the clothes for senior citizens.

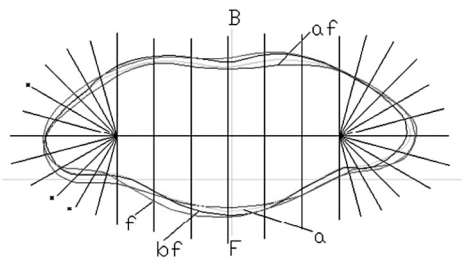
3. Analysis Results of the Mean Profiles by Somatotypes

For the manufacturing of the dress forms for elderly women, this study adopted 3-D analysis. Based on overlap cross-sections and the scanned human body wire frames, profiles were obtained. 1/2 waist thickness acted as the base of the side line. <Fig. 7> portrays mean profiles by using the Auto CAD program.

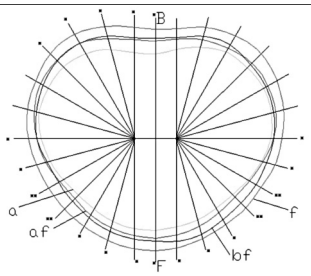
As in overlap cross-sections, Bend-forward Group has clear projection of abdomen and back. This profile difference must be an essential factor in pattern design. In Abdomen-fat Group, upper body looks like Average Group, and lower body resembles Fat Group. Generally with big sizes, Fat Group maintains right shapes.

4. Comparative Analysis of the Established Elderly Women's Dress Forms & Simulated Dress Forms

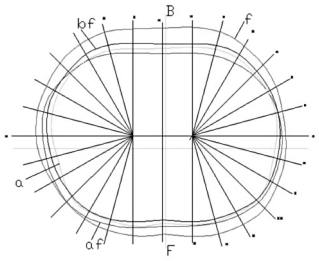
Actuality, dress forms for senior citizens are not manufactured in Korea and 1-D direct



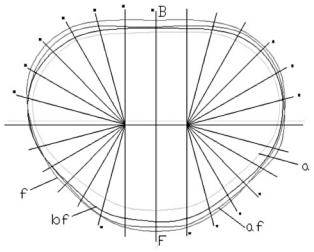
shoulder



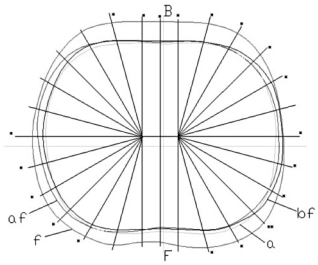
waist



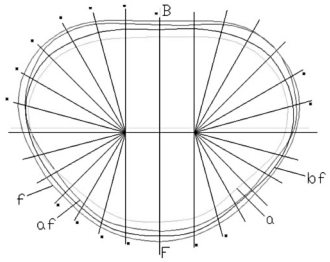
upper bust



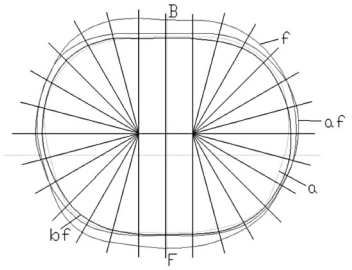
abdomen



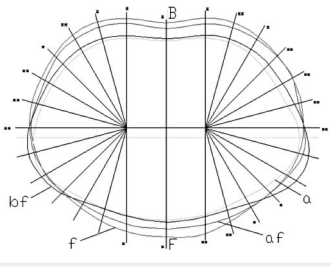
bust



hip part



upper bust

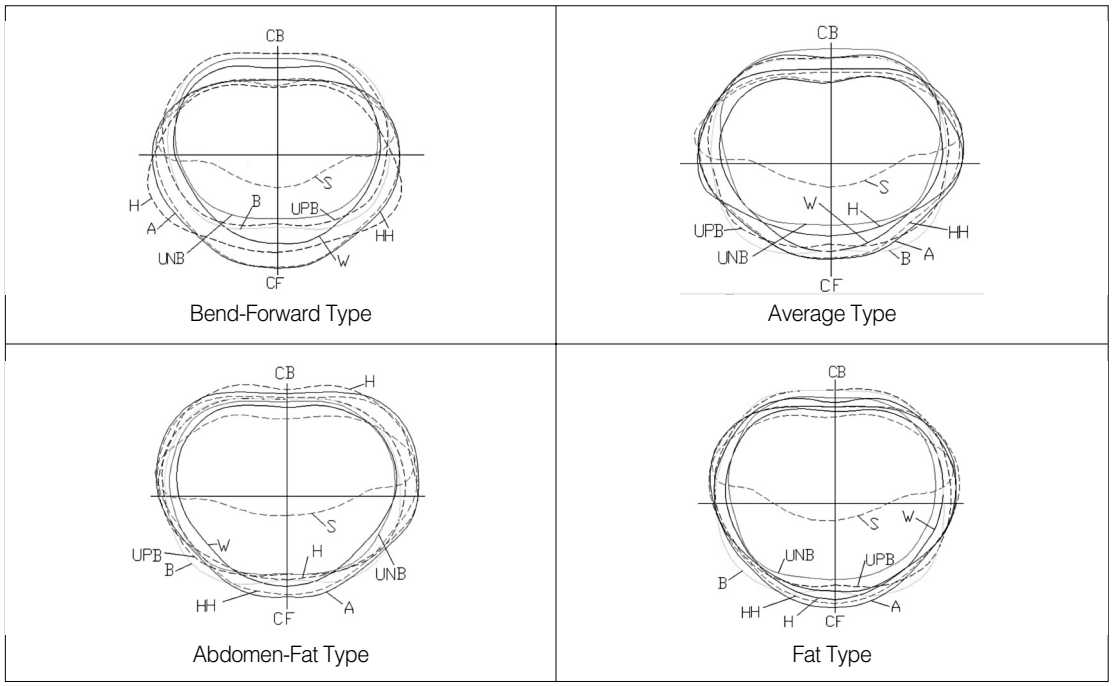


hip

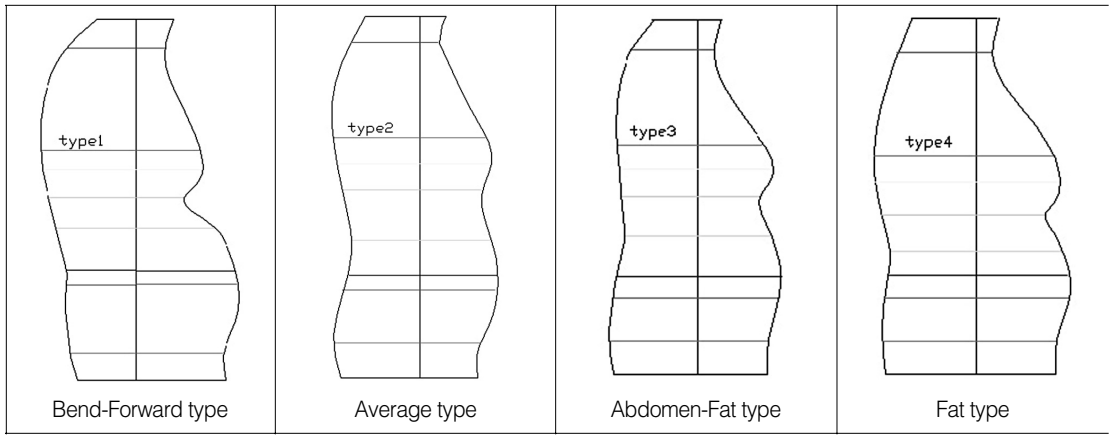
bf: bend-forward type a: average type af: abdomen-fat type f: fat type

<Fig. 5> Mean overlap cross-sections according to measurement areas

(* $p \leq 0.05$, ** $p \leq 0.01$)



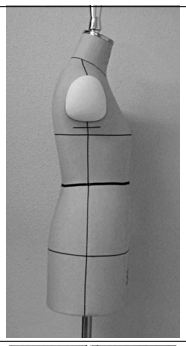
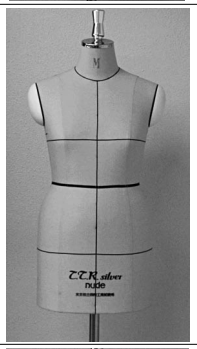
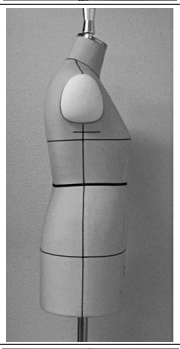
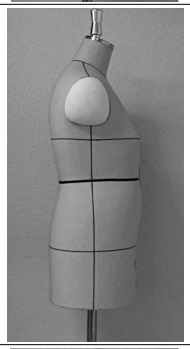
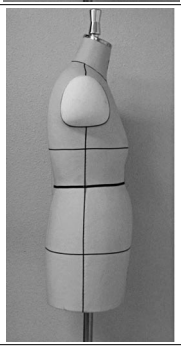
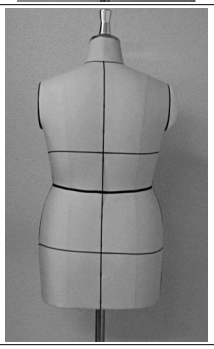
<Fig. 6> Mean overlap cross-sections according to somatotypes



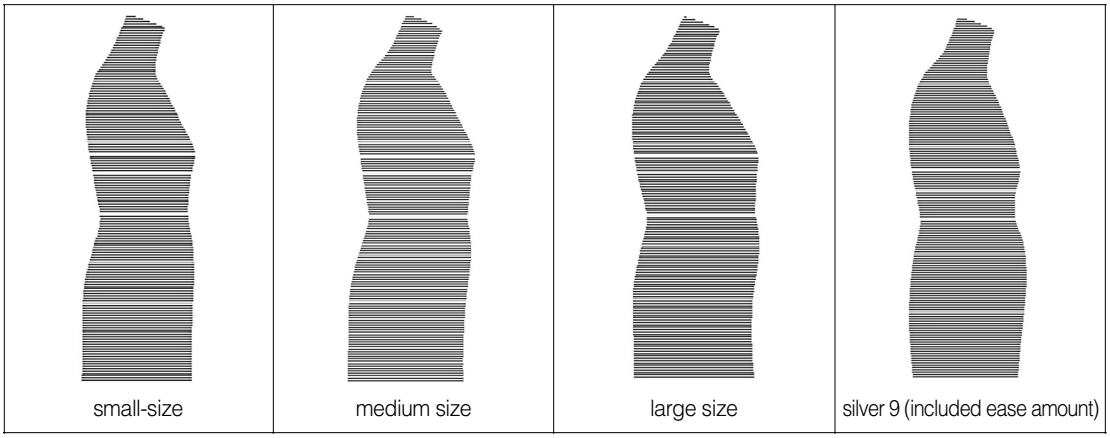
<Fig. 7> Mean profiles according to somatotypes

measurement data(girth or length etc.) are used for silver's pattern making. Thus this research analyzed Japan's elderly women's dress forms (see Fig. 8, 9) as well as human sizes and cross-sections by each somatotype.

Among Japan's dress forms, small, medium,

Small size			
Medium size			
Large size			
silver 9			
size	front	side	back

<Fig. 8> Elderly women's dress forms in Japan (TTR)



<Fig. 9> Profile comparison according to dress form sizes

and large sizes as well as the common "size 9 for silver" including the ease amount were analyzed. <Table 2> reveals the comparison of the dress form measurements with the average values of Korean elderly women.

In girth items, low neck girth was bigger in dress forms, but Korean mean values were bigger in most items. In particular, Korean old ladies had smaller hip girth than abdomen girth, but the opposite was true in dress forms.

In length items, front center, front, and back were similar. Shoulder length was shorter, but nipple length (SNP~BP) was longer in Korean aged females. As age increases, bust gets lowered, but dress forms don't faithfully reflect the body types of the aged.

In width and thickness items, waist was bigger in female Korean senior citizens. As in girth items, abdomen sizes were larger than hip sizes. As age grew, hip fat decreased, but abdomen fat increased. Thus, abdominal projection is obvious.

In other words, dress form dimensions are lower than the average values of Korean elderly women in most items. This means that Japanese counterparts have smaller body sizes than Korean aged women.

Therefore, in this study, somatotype characteristics should be properly reflected in the manufacturing of aged women's dress forms. However, the generalization of the results of this study needs prudence because the subjects of this study were limited to 15. The Narcis PB (Parametric Body) Model System is used in the present study to suggest a simulated dress from by somatotypes in <Fig. 10>.

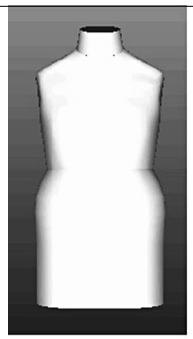
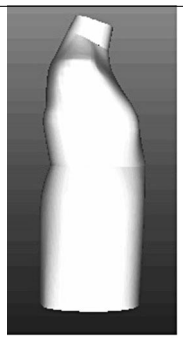
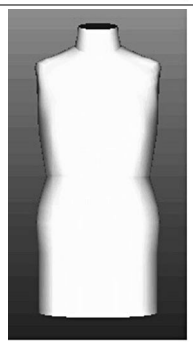
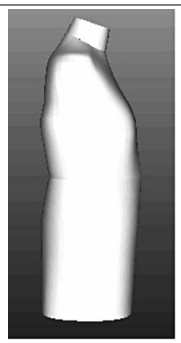
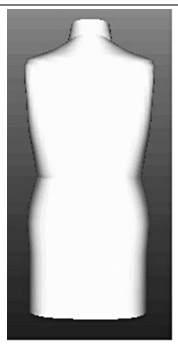
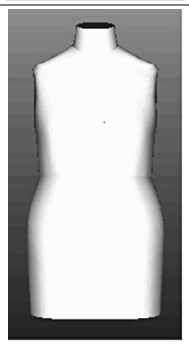
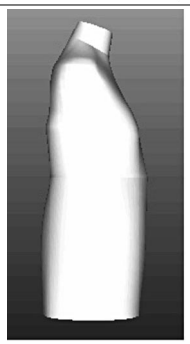
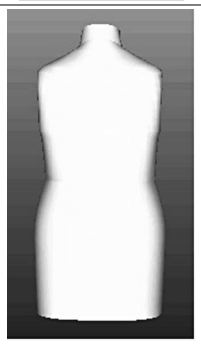
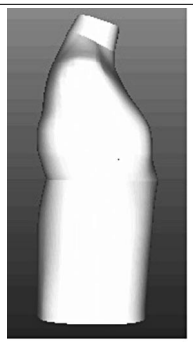
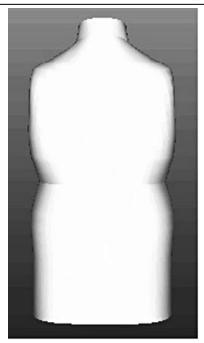
This dress form simulation well reflects overall somatotype traits in the front and at the back. Laterally, however, back bending and abdomen projection are scarcely covered. But comparatively speaking, this can be rather satisfactory.

For fitness and comfortable sense of wearing, somatotype characteristics must be considered in the design of elderly women's clothes. Instead of general small-medium-large size divisions, representative body type characteristics need to be reflected in the development of dress forms. As this study basically covered a minority of subjects, further in-depth studies might have to follow for the generalization of the findings here.

<Table 2> Measurement Results of Dress Form for Silver

(units: cm)

Measurement Items	small size	medium size	large size	silver 9 (included ease amount)	KSA 2002	
					70-74yrs	75-79yrs
neck base girth	38.2	39.5	40.0	42.0	38.4	38.4
upper bust girth	81.0	86.4	91.7	94.2	-	-
bust girth	80.0	85.5	91.7	91.5	94.1	92.7
under bust girth	74.3	82.5	88.8	85.0	-	-
waist girth	65.7	72.3	78.8	78.7	83.1	81.7
high hip girth	78.0	87.8	89.0	90.5	-	-
abdomen girth	82.0	89.0	91.5	93.6	94.8	93.8
hip girth	86.7	90.8	94.5	99.2	92.5	91.9
back length	36.5	36.5	36.8	38.5	36.9	36.4
back interscye length	34.5	36.0	36.5	38.5	35.4	34.6
sp to sp length	38.5	39.0	40.0	39.5	36.1	35.6
shoulder length	12.0	12.2	12.4	13.7	11.6	11.4
center front length	31.0	31.0	31.0	30.0	30.5	30.0
SNP to BP length	22.7	24.2	25.3	26.0	29.2	29.1
front length	36.0	36.8	37.0	36.5	38.3	37.8
front interscye length	31.3	32.0	34.0	34.0	-	-
hip length	18.5	19.5	21.0	21.0	-	-
upper bust width	28.3	29.7	30.3	35.0	-	-
bust width	26.7	28.0	29.6	32.5	29.2	28.7
under bust width	25.0	27.2	28.6	30.6	-	-
waist width	22.7	25.0	26.4	28.8	27.3	27.1
high hip width	28.2	31.4	31.0	33.4	-	-
abdomen width	29.7	32.0	32.2	34.6	32.2	31.6
hip width	31.5	32.5	33.6	36.8	32.0	31.9
shoulder depth	12.3	13.4	14.3	14.3	-	-
upper bust depth	19.6	21.0	23.6	21.3	-	-
bust depth	19.8	21.6	24.0	21.8	25.6	25.6
under bust depth	19.2	21.3	23.6	20.4	-	-
waist depth	17.6	19.8	22.0	19.8	23.8	23.5
high hip depth	19.7	22.7	23.7	22.5	-	-
abdomen depth	20.5	23.0	24.0	23.1	26.2	26.1
hip depth	21.2	23.4	24.2	23.8	24.7	25.1

Bend-Forward type			
Average type			
Abdomen-Fat type			
Fat type			

<Fig. 10> Simulated dress form based on the Narcis PB (Parametric Body) Model System

IV. Conclusions

The purpose of this study is to develop a dress form for elderly women according to their somatotype to be used for improving the fit of garments and pattern designs. The results of this study are as follows.

1. Comparing the body measurement data of the subjects with the nationwide average data of elderly women(KSA, 2002), we found that the difference was in $\pm 1\sigma$ in most of measurement items. Analyzing each somatotype, there was a significant difference among the 4 somatotypes in most of measure items. Bend-forward Group had shorter front length items. Abdomen-fat Group had lower upper-body values than Average Group and similar lower-body values to Fat Group. In most items except height, Fat Group had the biggest values.

2. Analyzing the mean cross-section according to the section measurement parts, no difference existed in shoulder part and under bust part. However, in upper bust, bust, waist, abdomen, high hip, and hip parts, a significant difference existed. Also, according to the results of the mean cross-section as well as the average cross overlap section for each somatotype, there was a significant difference among the four somatotypes. Thus, Abdomen-fat Group and Fat Group were similar, while Bend-forward Group and Average Group were alike. According to the increase of age, lower body tended to have more conspicuous changes.

3. According to the results of the profile of somatotypes, there existed a obvious significant difference among the 4 somatotypes, implying that the characteristics of somatotype need to be reflected when to develop dress forms for elderly women. Therefore, these differences must be an essential factor in pattern design.

4. Comparing the current dress form with the dress form developed with simulation, we could find that a dress form developed for elderly women which reflects the characteristics of body shape is much better than a dress form developed by simple size variation such as small, medium and large size divisions to improve the fit of garments and pattern designs.

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