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Development of All-in-one Collar Shirt's Pattern for Males

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Objective: The purpose of this study is to develop an all- in-one collar shirt with excellent appearance which is well suited to the body shape of the male adults.

Background: As men's casual wear has recently become more casual and the number of cool biz wearing in the summer has increased, a variety of shirt colors have been preferred in addition to shirt collar. However, studies on the design and pattern development of men's casual shirt collars are very rare. So we have identified the necessity of various development and research of men's shirts.

Method: We collected 8 all-in-one collar patterns for shirts from professional pattern books and men's shirt brands. Also, based on anthropometric data from the 6th Size Korea, we selected 5 subjects with measurements similar to the average adult men, manufactured shirts based on them and conducted a wearing test by 5 experts.

Results: After selecting shirts with good fit and appearance, we developed a prototype of all-in-one collar. As for front appearance evaluation, E1 pattern had the most outstanding shape and size, and C1 pattern had the most natural creases and front adjustment curves. As for side appearance evaluation, C1 had the highest overall scores, and E1 pattern on outer line. As for back appearance evaluation, C1 pattern had the highest score.

Conclusion: We suggested new all-in-one collar and shirt patterns. In addition, the prototype of the all-in-one collar shirt design was presented by reflecting results of the wearing test and preference survey.

Application: The shirt's design and patterns could be manufactured using the developed patterns. It will fit well with the body shape of adult males and will be highly satisfied by them.

Keywords: Men's shirt, Wearing test, All-in-one collar, Appearance test, Pattern

1. Introduction

As cool-biz wearing is established, most shirt brands for males release shirts with cool touch. Daks Shirts released the shirts manufactured with Hyosung's Askin, which is raw fiber for cooling shirt, and Kolon's ice cooler, which is multifunctional material for dry suction, quick-dry and UV interruption using ATB-UV. Woosung I&C YEZAC planned the shirts with cool touch using INVISTA's representative material, Coolmax, and S. J. DUKO's S. T. DUPONT CLASSICS launched linen and snow cotton shirts (Fashion Channel, 2015).

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In summer, many shirts worn without a necktie or by opening the neck without fastening buttons are adopted. Also, no band part cut open type all-in-one collars are released. Therefore, studies on shirt collar designs and patterns with comfortable fit in line with recent design trends are needed targeting such types of shirt collars.

An all-in-one shirt means an integrated collar not distinguishing collar band from collar like existing shirt collars (Armstrong, 2009) and refers to the collar worn by not fastening buttons and opening the neck part from the wearing type aspect. Since such a type of collar's fit has a huge impact on aesthetics and wearing sensation improvement upon wearing a shirt, it is essential to develop an aesthetic collar fitting for neck shape.

This study collected the existing patterns of all-in-one collar shirts targeting the books in the domestic and international clothing construction field and domestic men's clothing brands and comparatively analyzed pattern drafting methods. And then, this study selected the best all-in-one collar shirt through a wearing test for appearance. Based on the selection, this study aims to develop an all-in-one collar shirt with good fit to men's body characteristics.

2. Method

2.1 Shirt patterns

To develop an all-in-on collar pattern, this study selected and compared four types of patterns used in the industry and four types of patterns for academia.

Concerning the subjects, this study sampled five people within the range of ± standard deviation (SD) in the items of neck circumference, neck base circumference, chest circumference, based on the 6th Size Korea's Anthropometric Data for Male Adults, manufactured a shirt for experiment, and comparatively analyzed each pattern through a wearing test. This study presented all-in-one collar patterns reflecting the outstanding merits of the patterns highly evaluated in the appearance evaluation by an expert group of five experts and design preference as a result of a survey.

The all-in-one collar patterns used for this study were eight types in total: four types for education and four types for business. Figure 1 shows pattern drafting.

2.2 Subjects

The five subjects of this study belonging to average size range of males aged 20~29 in the 6th Size Korea's Anthropometric Data for Male Adults were sampled through purposive sampling. Table 1 shows the anthropometric items and measurement data.

The anthropometric measurement method presented by Size Korea was referred to, and Martin anthropometer was used, and also a tape measure and a goniometer were used as auxiliary instruments. Upon direct measurement, the subjects were instructed to bring both heels together and stand by spreading the front of each foot 30°, make back naturally straight, hold up head, and keep eyes forward (Shim, 2003).

2.3 Pattern making of the shirts used in evaluation test

The pattern drafting of a shirt for experiment was based on the shirt patterns of Cho (2014) and reflected the characteristics of wearing with unbuttoning, which is a common thing of existing all-in-one collar shirts. Therefore the first button in the general shirt collar band was excluded, and the first button's location was set up at the second button location. Given that there was no

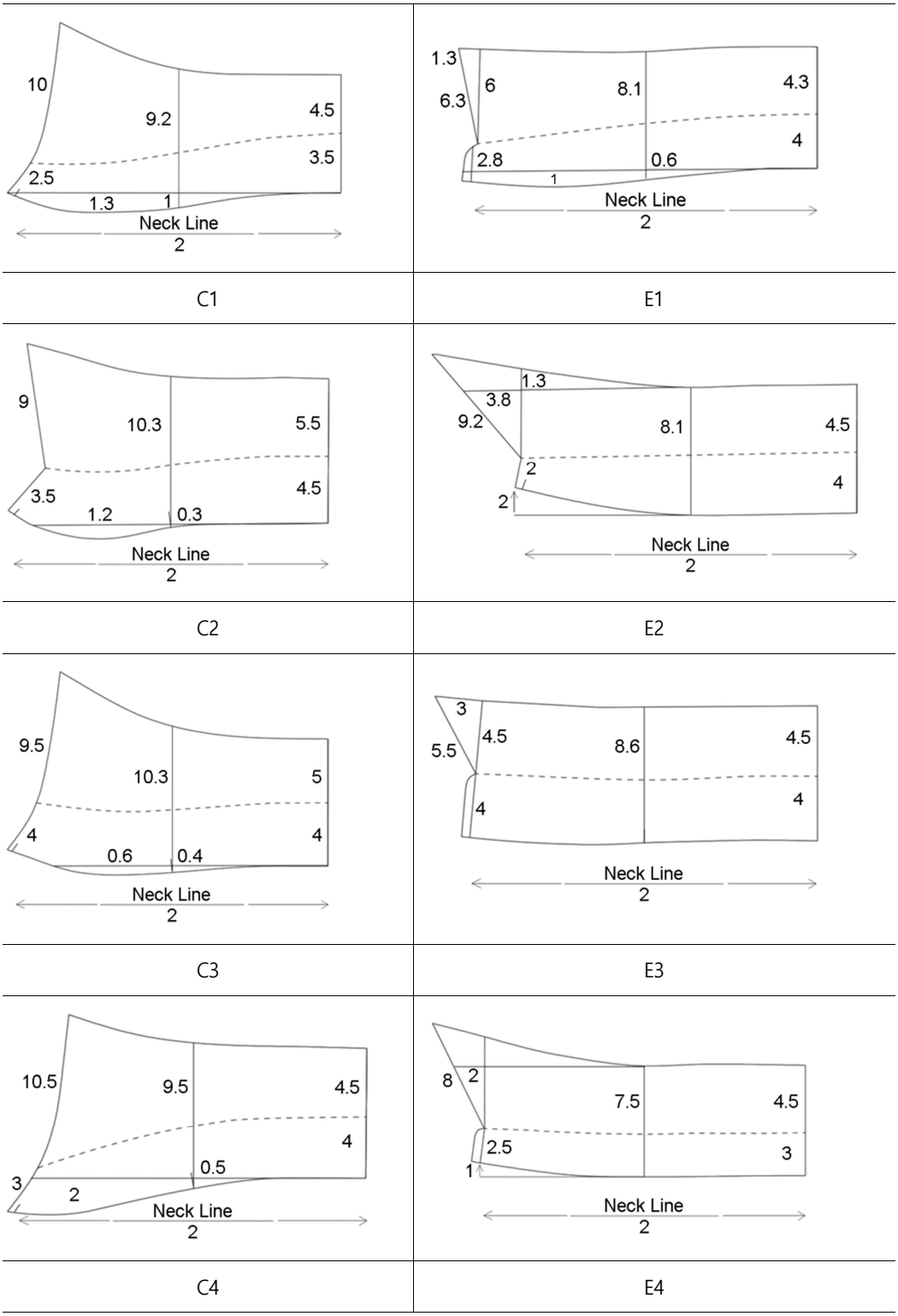


Figure 1. Collar patterns used in the experiment Cho (2014), Kawashima (1995), Kim (1998), Kyoko (1997) unit: cm

Table 1. The measurements of the subjects unit: cm, °

Item	20~29 Mean (S.D.)	Subject Mean (S.D.)	Subject				
			A	B	C	D	E
Stature	173.58 (5.47)	173.84 (.42)	173.5	174.0	173.7	174.5	173.5
Weight	70.91 (1.02)	70.18 (3.54)	73.7	71.7	66.9	72.7	65.9
Chest breadth	21.25 (1.99)	20.40 (.82)	21.0	20.0	20.0	21.5	19.5
Bust breadth	21.99 (2.12)	21.70 (.31)	22.0	22.0	21.5	21.7	21.3
Waist depth (omphalion)	20.38 (2.54)	20.20 (0.57)	20.0	20.5	19.5	21.0	20.0
Neck circumference	36.90 (2.07)	37.20 (.45)	37.0	37.5	37.5	37.5	36.5
Neck base circumference	43.05 (2.34)	43.42 (0.28)	43.1	43.2	43.8	43.5	43.5
Chest circumference	95.13 (6.33)	94.86 (.59)	95.5	94.5	94.5	95.5	94.3
Hip circumference	94.15 (5.78)	98.60 (0.55)	98.0	99.0	99.0	99.0	98.0
Waist circumference	80.02 (8.09)	80.80 (3.90)	83.0	77.0	77.0	86.0	81.0
Cervical height	148.10 (5.19)	147.72 (.35)	147.5	148.3	147.8	147.5	147.5
Acromion height	140.04 (4.94)	140.52 (1.31)	138.5	141.0	141.3	141.8	140.0
Anterior neck height		141.78 (1.17)	140.2	141.8	141.8	143.5	141.6
Lateral neck height		146.46 (.72)	145.7	147.6	146.0	146.5	146.5
Waist front length	37.64 (2.11)	38.50 (1.00)	40.0	39.0	38.0	38.0	37.5
Waist back length	43.77 (2.45)	44.16 (.48)	44.5	44.5	43.5	44.5	43.8
Bishoulder length	43.02 (2.67)	43.80 (.27)	44.0	44.0	43.5	43.5	44.0
Arm length	58.84 (2.63)	58.60 (.42)	59.0	58.5	58.5	59.0	58.0
Back interscye length	41.18 (2.70)	39.80 (.27)	40.0	40.0	39.5	40.0	39.5
Front interscye length	36.89 (2.14)	36.96 (.09)	37.0	36.8	37.0	37.0	37.0
Right shoulder angle	22.02 (.36)	23.80 (1.64)	22.0	25.0	25.0	22.0	25.0
Left shoulder angle	21.67 (.35)	22.00 (1.73)	21.0	21.0	21.0	22.0	25.0

20~29 Mean: Size Korea Projects 2010 The Sixth

Table 2. Physical properties of the shirt used in the experiment

Test item		Outer	Fusible interfacing
Fiber content (%)		Cotton 100%	Cotton 100%
Weave		1/2 Twill	Plain
Fabric count (threads/5.0cm)	Warp	334.6	214.4
	Weft	147.4	132.6

Table 2. Physical properties of the shirt used in the experiment (Continued)

Test item		Outer	Fusible interfacing
Linear density (Nm)	Warp	67.2	29.3
	Weft	63.5	32.1
Tensile strength (N)	Warp	320	230
	Weft	200	170
Thickness (mm)		0.20	0.28
Weight (g/m^2)		103.3	142.3

band part, drafting was conducted by reducing the width for closure of collar band.

The collar patterns were manufactured using the 100% cotton material for shirt in reflection of the physical properties of the collected all-in-one collar shirts, and Table 2 shows the analysis results of the physical properties.

3. Result & Discussion

3.1 Evaluation test on wearing shirts

Experts' appearance evaluation on the shirt for experiment consisted of the questions related with the fit of dimensions and appearance. Each pattern was evaluated from the front, side, back and bird's eye views, and the Friedman test was carried out on eight types of patterns in total to identify significant differences. This study exhibited the questions with the highest mean score

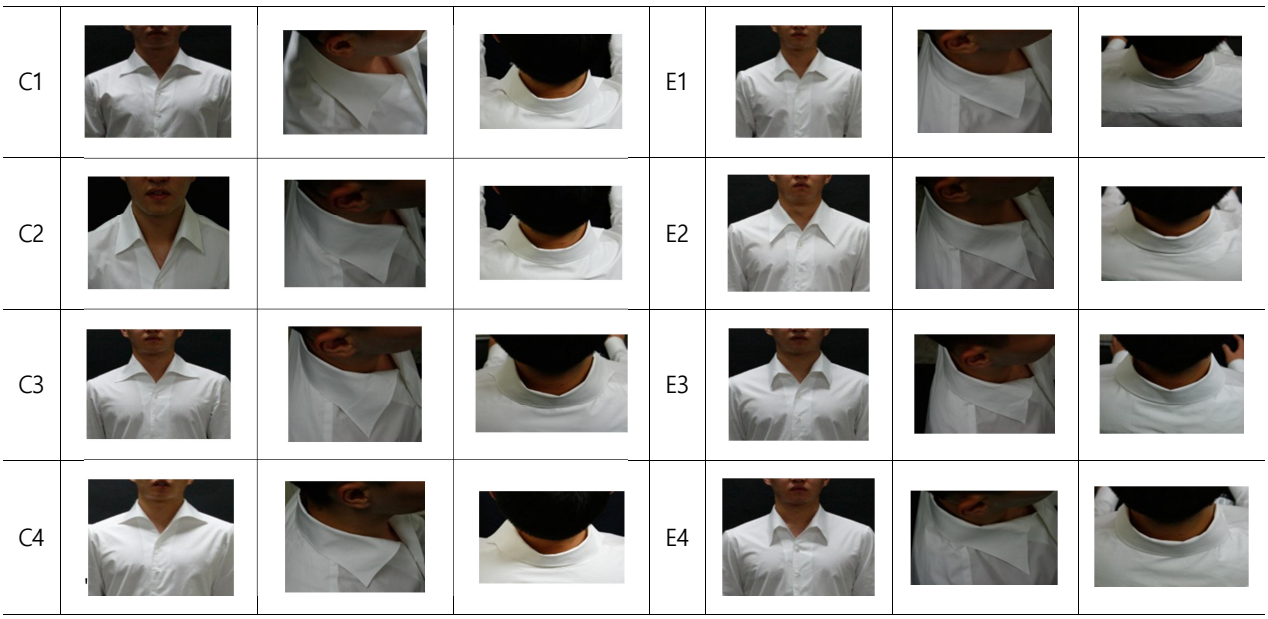


Figure 2. Evaluation test for appearance and fit analysis

among those patterns regarding the questions with significant differences. Figure 2 shows Evaluation test.

Table 3 shows the front appearance evaluation result by experts' appearance evaluation. C2 and E1 received positive evaluation with 3.84 and 3.68 points, respectively, in the question of "Collar stands well". In the question of "Outer collar curve and neck base circumference are adequately distanced", E1 scored 3.64 points, and the distance between outer collar curve and neck base circumference were the most adequate, and C1 was the second most adequate with 3.32 points. In the question of "Stand width is adequate", E1 received 3.68 points, and its stand width was the most adequate, followed by C1 receiving 3.56 points. In the question of "Collar has natural look overall", E1 received 3.84 points, and thus its collar had the best natural look overall, and C1 received 3.36 points, and its collar had the second best natural look overall. In the question of "No wrinkles are on the collar", C1

Table 3. Experts' appearance evaluation by patterns_front view n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman χ^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Front	Collar has natural look overall	3.36 (.81)	3.24 (.78)	2.76 (.72)	3.04 (.73)	3.84 (.62)	1.96 (.89)	2.36 (.57)	2.48 (.65)	75.143***
	No wrinkles are on the collar	4.04 (.20)	4.00 (.00)	3.28 (.94)	3.88 (.33)	3.96 (.54)	3.96 (.20)	4.00 (.00)	3.96 (.20)	40.888***
	Collar fits well to side neck gradient	3.84 (.37)	3.36 (.76)	3.08 (.81)	3.52 (.77)	3.96 (.20)	3.24 (.78)	2.84 (.75)	3.32 (.80)	46.538***
	Collar stands well	3.64 (.64)	3.84 (.69)	3.36 (.86)	3.68 (.48)	3.84 (.37)	3.52 (.71)	3.36 (.49)	3.64 (.64)	18.363**
	Outer collar curve is natural	3.40 (.76)	3.32 (.90)	3.00 (.96)	3.48 (.65)	3.96 (.20)	2.36 (1.15)	2.88 (.88)	2.88 (.88)	47.805***
	Collar crease curve is natural	3.68 (.63)	3.16 (.90)	3.04 (.89)	3.40 (.76)	3.60 (.65)	2.64 (.86)	2.68 (.63)	2.84 (.69)	48.815***
	Outer collar curve and bottom neck girth are adequately distanced	3.32 (.80)	3.28 (.74)	2.96 (.89)	3.16 (.85)	3.64 (.86)	3.20 (.76)	2.84 (.62)	3.04 (.68)	23.988**
	Side neck and collar crease are adequately distanced	3.40 (.76)	3.20 (.87)	2.64 (.95)	3.28 (.84)	3.60 (.76)	3.00 (.76)	2.64 (.57)	3.20 (.65)	40.819***
	Collar size is adequate	3.08 (.91)	2.76 (.93)	2.12 (.78)	3.12 (.88)	3.92 (.49)	1.72 (.89)	2.84 (.85)	2.44 (.65)	70.583***
	Stand width is adequate	3.56 (.71)	3.12 (1.01)	3.12 (.78)	3.32 (.80)	3.68 (.90)	3.08 (.70)	2.92 (.81)	3.16 (.62)	22.421**
	Stand front adjustment curve looks natural	3.76 (.44)	3.60 (.58)	3.48 (.77)	3.76 (.44)	3.28 (1.10)	2.68 (.99)	2.28 (.68)	2.40 (.65)	75.493***
	Collar ends are adequately distanced	2.08 (.86)	2.80 (.96)	1.56 (.71)	1.76 (.88)	3.48 (1.05)	2.32 (.90)	2.88 (.73)	2.68 (.69)	71.495***
Average		3.43 (.36)	3.31 (.51)	2.90 (.51)	3.28 (.35)	3.73 (.37)	2.81 (.45)	2.88 (.25)	3.00 (.29)	70.659***

■: Shadow indicates maximum value
- All items are rated on a 5-point scale (1: Strongly disagree ⟶ 5: Strongly agree)
- *: $p<.05$, **: $p<.01$, ***: $p<.001$

scored 4.04, and it had least wrinkles, followed by C2 and E3 with 4.00 points, respectively. In the question of "Collar fits well the side neck gradient", E1 received 3.96 points, and its collar fitted well the side neck gradient the most, followed by C1 with 3.84 points. In the question of "Outer collar curve is natural", E1 received 3.96 points, and its outer collar curve was the most natural, and C4 receiving 3.48 points showed the second most natural outer collar curve. In the question of "Collar crease curve is natural", C1 receiving 3.68 points showed the most natural collar crease curve, and E1 receiving 3.60 points showed the second most natural collar crease curve. In the question of "Side neck and collar crease are adequately distanced", E1 received 3.60 points and its side neck and collar crease were the most adequately distanced. In the question of "Collar size is adequate", E1 received 3.92 points, and its collar size was the most adequate. In the question of "Stand front adjustment curve looks natural", C1 and C4 received 3.76 points, respectively, and their stand front adjustment curves looked the most natural. In the question of "Collar ends are adequately distanced", E1 scored 3.48 points and its distance from collar point to collar point was the most adequate.

Table 4 shows the experts' side appearance evaluation result. In the question of "Collar covers bottom neck base circumference line well", C1 scored 3.92 points, and E1 scored 3.02 points, and their collars covered bottom neck base circumference line the best, followed by E4 scoring 3.84 points. In the question of "No wrinkles are on the collar", C1 scored 4.00 points, and it had the least wrinkles on the collar, and E4 scoring 3.06 points showed the second least wrinkles on the collar. In the question of "Collar is not slant forward", C1 scored 3.68 points, and its collar was not slant forward the most, followed by C2 and C3 scoring 3.52 points, respectively. In the question of "The front adjustment curve of stand looks natural", C1 and C4 scored 3.76 points, respectively, and their front adjustment curves of stand looked natural the most. In the question of "Stand width is adequate", C1 and C4 scored 3.84 points, respectively, and their stand width was the most adequate. E1 scored 3.56 points, and its stand width was the second most adequate. In the question of "Outer collar curve is natural", E1 scored 3.76 points, and its outer collar curve was the most natural, followed by C1 scoring 3.52 points. In the question of "Collar crease curve is natural", E1 scored 3.54 points, and its collar crease curve was the most natural, followed by C1 that scored 3.17 points. In the question of "Collar width is adequate", E1

Table 4. Experts' appearance evaluation by patterns_side view n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman χ^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Side	Collar covers bottom neck circumference line well	3.80 (.58)	3.92 (.28)	3.40 (.91)	3.64 (.64)	3.92 (.40)	3.48 (.87)	3.36 (.86)	3.84 (.37)	21.728**
	No wrinkles are on the collar	3.72 (.54)	4.00 (.00)	3.28 (.94)	3.88 (.44)	3.88 (.33)	3.72 (.68)	3.88 (.33)	3.96 0.20)	29.858***
	Collar is not slant backward	3.48 (.82)	3.48 (.87)	3.40 (.71)	3.28 (.94)	3.48 (.77)	3.80 (.91)	3.64 (.64)	3.72 (.68)	7.808
	Collar is not slant forward	3.68 (.56)	3.52 (.77)	3.52 (.65)	3.72 (.68)	3.28 (.84)	2.08 (.95)	2.72 (.84)	2.40 (1.00)	64.351***
	The front adjustment curve of stand looks natural	3.76 (.44)	3.64 (.57)	3.48 (.65)	3.76 (.52)	3.28 (.89)	2.68 (.85)	2.44 (.77)	2.60 (.65)	66.325***
	Collar fits well to rear neck gradient	3.60 (.65)	3.40 (.76)	3.24 (.72)	3.56 (.65)	3.44 (.77)	3.20 (.65)	3.36 (.57)	3.28 (.61)	13.265
	Stand width is adequate	3.84 (.47)	2.92 (.95)	3.16 (.85)	3.84 (.47)	3.56 (.82)	3.32 (.75)	3.28 (.79)	3.52 (.71)	30.338***
	Outer collar curve is natural	3.52 (.71)	3.48 (.71)	2.96 (.79)	3.44 (.77)	3.76 (.52)	2.28 (.98)	3.08 (.91)	2.88 (.83)	49.384***

Table 4. Experts' appearance evaluation by patterns_side view (Continued) n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman X^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Side	Collar crease curve is natural	3.17 (.87)	3.04 (.81)	2.96 (.81)	3.08 (.83)	3.54 (.83)	2.58 (.78)	2.79 (.72)	2.71 (.62)	38.270***
	Outer collar curve and bottom neck girth are adequately distanced	3.64 (.57)	3.52 (.71)	3.28 (.74)	3.36 (.76)	3.48 (.71)	3.28 (.61)	3.08 (.76)	3.40 (.58)	10.735
	Collar width is adequate	3.52 (.82)	3.04 (.93)	2.56 (.87)	3.40 (.87)	3.60 (.82)	2.96 (.84)	3.12 (.78)	2.92 (.81)	28.857***
	Collar style is natural	3.56 (.71)	3.48 (.71)	3.04 (.73)	3.32 (.80)	3.80 (.50)	1.96 (.98)	2.60 (.87)	2.64 (.91)	65.714***
Average		3.60 (.31)	3.45 (.42)	3.18 (.43)	3.51 (.32)	3.58 (.35)	2.96 (.41)	3.11 (.34)	2.92 (.18)	74.254***

■: Shadow indicates maximum value
- All items are rated on a 5-point scale (1: Strongly disagree ⟶ 5: Strongly agree)
- *: $p<.05$, **: $p<.01$, ***: $p<.001$

scored 3.60 points, and its collar width was the most adequate. In the question of "Collar style is natural", E1 scored 3.80, and its collar style was the most natural. As a result of appearance evaluation from the comprehensive aspect, C1 pattern scored the highest score, followed by E1, C4, C3, and C3.

Table 5 shows experts' back appearance evaluation result. In the question of "No wrinkles are on the collar", C1 scored 4.04 points,

Table 5. Experts' appearance evaluation by patterns_back view n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman X^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Back	Location of bottom neck circumference line is adequate	4.00 (.41)	3.44 (.65)	3.88 (.33)	3.56 (.51)	3.64 (.70)	3.72 (.54)	3.56 (.58)	3.64 (.64)	19.849**
	No wrinkles are on the collar	4.04 (.35)	3.80 (.50)	3.84 (.37)	3.76 (.44)	3.68 (.69)	3.88 (.44)	3.92 (.28)	3.92 (.49)	14.781*
	Center back line is adequately located	3.92 (.40)	3.56 (.58)	3.60 (.65)	3.40 (.65)	3.44 (.82)	3.84 (.55)	3.64 (.49)	3.80 (.50)	21.544**
	Outer collar curve does not hang from neck line	3.52 (.87)	2.40 (.76)	3.36 (.86)	2.60 (.71)	3.40 (.91)	2.96 (.79)	2.88 (.78)	3.24 (.83)	34.289***
	Collar covers bottom neck circumference line well	3.96 (.54)	3.48 (.59)	3.80 (.50)	3.44 (.51)	3.76 (.44)	3.60 (.58)	3.56 (.51)	3.72 (.46)	19.758**
	Stand width is adequate	4.08 (.40)	2.48 (.87)	3.20 (.87)	3.72 (.68)	3.56 (.77)	3.72 (.61)	3.60 (.65)	3.36 (.81)	46.900***
	Collar width is adequate	4.00 (.58)	2.72 (.94)	3.36 (.76)	3.84 (.47)	3.56 (.77)	3.64 (.70)	3.52 (.77)	3.40 (.82)	34.415***

Table 5. Experts' appearance evaluation by patterns_back view (Continued) n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman χ^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Back	Neck and outer collar curve are adequately distanced	3.92 (.64)	3.20 (.87)	3.76 (.44)	3.24 (.72)	3.64 (.76)	3.76 (.60)	3.36 (.57)	3.56 (.58)	25.877**
	Neck and collar crease are adequately distanced	3.32 (.95)	2.96 (.93)	3.44 (.77)	3.48 (.65)	3.32 (.90)	3.76 (.60)	3.36 (.64)	3.52 (.65)	15.023*
	Outer collar curve is natural	3.92 (.49)	3.36 (.76)	3.80 (.50)	3.44 (.65)	3.60 (.71)	3.80 (.50)	3.52 (.65)	3.68 (.63)	18.823**
	Collar crease is natural	3.72 (.84)	2.96 (.89)	3.20 (.82)	3.32 (.63)	3.52 (.82)	3.48 (.71)	3.36 (.76)	3.16 (.90)	19.535**
Average		3.85 (.40)	3.12 (.46)	3.57 (.33)	3.44 (.35)	3.56 (.50)	3.65 (.29)	3.48 (.34)	3.55 (.34)	34.625***

■: Shadow indicates maximum value
- All items are rated on a 5-point scale (1: Strongly disagree ⟶ 5: Strongly agree)
- *: p<.05, **: p<.01, ***: p<.001

and its collar had the least wrinkles, and E3 and E4 scored 3.92 points, respectively, and their collars had the second least wrinkles. In the question of "Neck and collar crease are adequately distanced", E2 scored 3.76, and its neck and collar crease were the most adequately distanced, followed by E4 that scored 3.52 points.

Table 6 shows the experts' appearance evaluation result of bird's eye view. According to experts' appearance evaluation result, in the questions of "Top collar style is natural", "Collar and side neck are adequately distanced", and "Collar and front neck are adequately distanced", significant differences were revealed. In the question of "Collar and front neck are adequately distanced", E1 scored 3.84 points, and its collar and neck were the most adequately distanced, followed by C1 scoring 3.60 points. In the

Table 6. Experts' appearance evaluation by patterns_bird's eye view n=5, mean (S.D.)

Evaluation question		Pattern code								Friedman χ^2
		C1	C2	C3	C4	E1	E2	E3	E4	
Bird's eye view	Top collar style is natural	3.60 (.87)	3.00 (1.00)	3.16 (.80)	3.40 (.71)	3.68 (.75)	2.92 (1.04)	2.88 (.78)	3.16 (.85)	26.812***
	Collar and back neck are adequately distanced	3.00 (1.15)	2.80 (1.22)	2.60 (.91)	2.96 (1.10)	3.24 (1.01)	2.76 (.97)	2.56 (1.04)	2.96 (.98)	8.387
	Collar and side neck are adequately distanced	3.56 (.87)	3.00 (1.04)	2.60 (.91)	3.36 (.76)	3.56 (.87)	3.00 (.96)	2.76 (.78)	3.16 (.80)	27.709***
	Collar and front neck are adequately distanced	3.60 (.82)	3.48 (.77)	3.32 (.69)	3.48 (.71)	3.84 (.75)	3.08 (.76)	3.08 (.70)	3.52 (.65)	24.673**
Average		3.44 (.69)	3.07 (.79)	2.92 (.57)	3.30 (.57)	3.58 (.64)	2.94 (.56)	2.82 (.62)	3.20 (.47)	31.879***

■: Shadow indicates maximum value
- All items are rated on a 5-point scale (1: Strongly disagree ⟶ 5: Strongly agree)
- *: p<.05, **: p<.01, ***: p<.001

question of "Top collar style is natural", E1 scored 3.68 points, and its top collar style was the most natural. C1 scored 3.60 points, and its top collar style was the second most natural. In the question of "Collar and side neck are adequately distanced", C1 and E1 scored 3.56 points, respectively, and their collars and side necks were the most adequately distanced, followed by E4 that scored 3.26 points. As a result of appearance evaluation on bird's eye view, E1 pattern scored the highest score, followed by C1, C4, E4, and C2 in order. However, C3, E2, and E3 showed 3 or lower points in view of mean score on birds' eye view, and thus the bird's eye view appearance was not good.

Table 7 shows the evaluation result on the mean scores of front, side, back, and bird's eye views.

Table 7. Average of experts' appearance evaluation by patterns n=5, mean (S.D.)

Evaluation question	Pattern code								Friedman χ^2
	C1	C2	C3	C4	E1	E2	E3	E4	
Average of evaluation test in Front, Side Back and Bird's eye view	3.57 (.32)	3.22 (.44)	3.13 (.38)	3.38 (.25)	3.61 (.34)	3.09 (.31)	3.06 (.21)	3.17 (.19)	69.2429***

■: Shadow indicates maximum value
- All items are rated on a 5-point scale (1: Strongly disagree ⟶ 5: Strongly agree)
- *: $p<.05$, **: $p<.01$, ***: $p<.001$

In the overall appearance evaluation on the front, side, back, and bird's eye views, E1 was evaluated to receive the highest score, followed by C1, C4, C2, C3, E4, E2, and E3 in order. Overall, those patterns received higher than average score; however, the patterns used in the industry, rather than for academia, received slightly higher scores in the evaluation on the front, side, back, and bird's eye views, except E1.

4. Development of All-in-one Collar Shirt Pattern

As a result of the wearing test among the patterns, this study designed a shirt pattern reflecting the design and detail preference results through a questionnaire survey based on the pattern that received the best evaluation. And then, this study drafted and made an all-in-one collar shirt pattern for research reflecting the drafting characteristics of the patterns receiving excellent evaluation through the shirt wearing test utilizing the all-in-on collar patterns.

4.1 Designing & drafting of all-in-one collar & shirt pattern

Upon all-in-one collar pattern drafting for research, this study utilized the basic dimensions of collar total height, top collar height, and stand height, based on the pattern receiving the best back appearance evaluation. This study substituted the base line length

Table 8. Measurements used in drafting the shirt pattern unit: cm, °

Collar total height	Top collar height	Stand height	Side neck perpendicular line	Collar angle (°)	Collar position angle (°)	Front collar curve point	Top collar length base line	Outer collar curve	Closure at neck
8	4.5	3.5	9	80	70	1.5	6.5	23.2	0.5

to utilize the collar position angle and top collar length of E1 that received the best front appearance evaluation. This study also utilized C1 pattern type receiving the best evaluation on the side view, and drafted a pattern by naturally connecting the front collar position angle and collar total height type. The result values are shown in Table 8, and the flat sketches are shown in Figure 3.

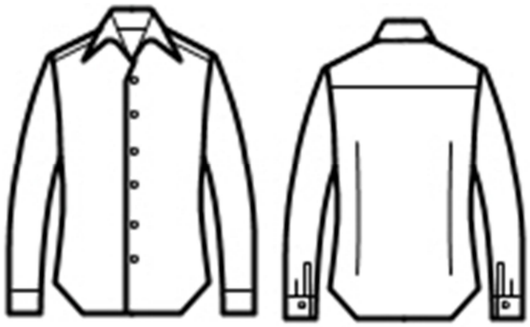
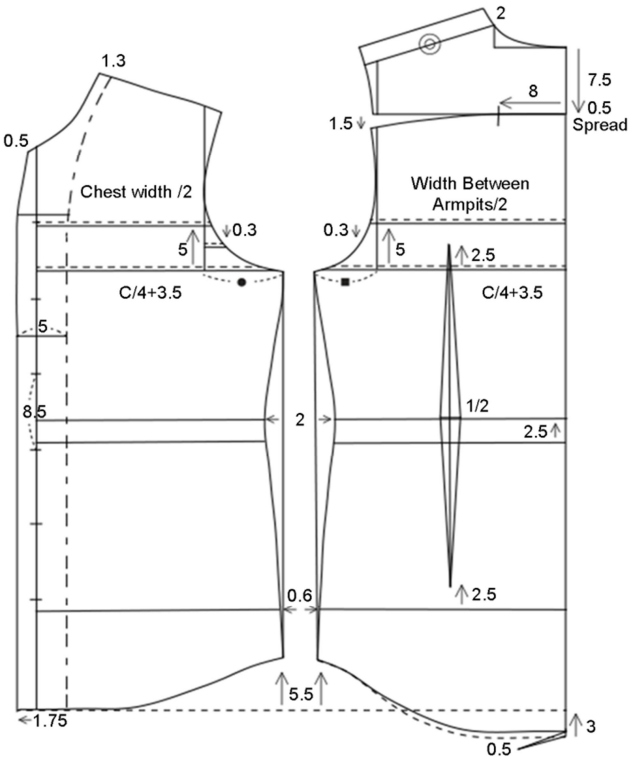
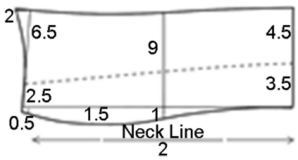


Figure 3. Flat sketches for shirt designing

The pattern used upon making an all-in-one collar shirt was based on the shirt pattern drafting of Cho (2014), and the research of this study revised the pattern by applying the details surveyed in the fact-finding survey for wearing of male shirts. For all-in-one collar application, the neck line was set up by moving 1.25cm diagonal from the center front line to neck circumference line. The all-in-one collar pattern was drafted by applying each part's drafting dimensions of the pattern revealed to be outstanding through the wearing test mentioned above. Figure 4 shows the drafted shirt for experiment.





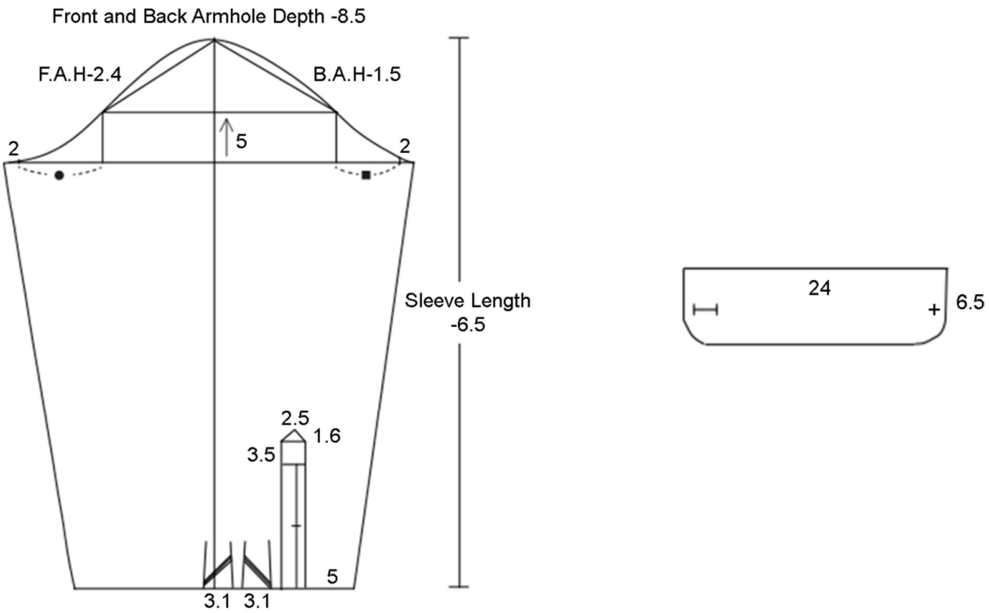


Figure 4. The prototype shirt patterns with all-in-one collar (1/5 scale down)

4.2 Prototyping all-in-one collar shirt

This study used cotton 100% material. For armhole sewing, 301 single-needle lockstitch and mock flat felled seam (SSw) were used, and for side seam and underarm seam, 301 single-needle lockstitch and flat felled seam (SSw) were used. For front placket and facing, 301 single-needle lockstitch (SSae) was used. For bottom opening seam, 301 single-needle lockstitch and clean finished hem (EFb) sewing techniques were utilized. The all-in-one collar shirt made for research is shown in Figure 5. Table 2 above shows

Front	Side	Back

Figure 5. The prototype of all-in-one collar shirt

the physical properties of the fabric used in this study.

5. Conclusion

This study made 8 experimental shirts by collecting the representative eight types of patterns with outstanding fit and aesthetics for the development of an all-in-one collar shirt. After that, this study selected five subjects with size close to the mean size of the 6th Size Korea's Anthropometric Data for Male Adults, and chose outstanding patterns through a wearing test by an expert group consisting of five experts. This study drafted a prototype shirt with the design reflecting the all-in-one collar shirt pattern drafting method by Cho Keukyoung and shirt detail preference according to the survey result.

The results of this study are as follows:
First, this study made 8 shirts for experiment by selecting eight patterns, after collecting and drafting four types of patterns used in the industry and four types for academia in order to develop an all-in-one collar pattern. They were made with cotton 100% fabric for shirt to have the same physical properties of material as those of all-in-one collar shirts sold in the market.

Second, this study carried out a wearing test by an expert group. As a result of appearance evaluation on the eight types of patterns, significant differences were revealed in the total questions. E1 pattern was highly evaluated in terms of front total shape and size from the front average appearance evaluation. Significant differences were shown in nine questions out of 12 questions in total as a result of questions on side view. From the average side appearance evaluation, C1 received the highest evaluation. According to the back evaluation result, significant differences were shown in all questions. From the average back appearance evaluation, C1 received the highest score. Significant differences were revealed in three questions out of four questions in total as a result of evaluation on the bird's eye view. From the average appearance evaluation on the bird's eye view, E1 received the highest evaluation.

Third, this study referred to the E1 pattern receiving the highest score and the C1 pattern receiving the second highest score as a result of the wearing test of the eight types of patterns selected to present the final prototype of the all-in-one collar pattern. The pattern drafting method of the shirt for experiment was based on the shirt pattern drafting by Cho (2014). This study developed a research pattern with the design of total slim fit, no dart in the front panel, one dart in the back panel, and one button in the round cuffs reflecting the feature of wearing by unbuttoning, which is a common thing in existing all-in-on shirts, and the design preference. This study drafted as follows: 8cm for total collar height, 4.5cm for top collar height, 3.5cm for stand height, 9cm for side neck perpendicular line, 80° for collar angle, 70° for collar position angle, 1.5cm for front collar curve point, 6.5cm for top collar length guide line, 23.2cm for outer collar line, and 0.5cm for width for closure.

This study made and presented a prototype shirt utilizing the developed pattern as above.

The limitations of this study are presented below:
This study targeted only male adults in their 20s with average neck type regarding the wearing test, therefore, an extended study targeting various age groups and different neck types is needed. Since the wearing test on the developed research prototype was not carried out in this study, a further study on additional wearing test will be conducted.

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