

## Fabric manipulation techniques with optical illusion as design solutions for different woman's body types

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### Abstract:

This research is an innovative design attempt to create a single design model that fits many different types of the human body in women by dealing with reversible fabrics with fabric manipulation techniques in light of the application of the concept of optical illusion. The research relied on comparing two innovative types of fabrics using the technique of slashed tuck and 3d origami using cutting patterns, and they were applied to 4 different patterns of the woman's body, so that 12 designs were produced for each of them, and accordingly a statistical study was conducted to find out the most suitable of these two techniques for each type separately and the best of them in general, which is 3d origami using cutting patterns technique.

### Keywords:

Optical Illusion ,  
Reversible Fabrics ,  
Fabric Manipulation.

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### Introduction:

The different body styles of women are one of the biggest obstacles in choosing the clothes that suit them, and if we add to the above the overwhelming desire of women to permanently change their external appearance by using clothes, then this is one of the biggest difficulties they face. The researcher noticed the tireless attempt of fashion designers to address this problem in designing women's clothes, but this was always costing manufacturers and producers a lot of money due to the return of clothes that do not fit the different styles of a woman's body (1), and if we know that the different styles of a woman's body fall under it a lot of diversity, which is impossible with traditional methods. That it fits one size, for example (hourglass body, rectangle body, pear body, inverted triangle body and apple body (2)(3). Therefore, this research is an unconventional attempt to propose a design that fits several patterns simultaneously by dealing with reversible fabrics with the technique of manipulating fabrics under the application of the concept of optical illusion.

### Problem statement:

The research problem can be summarized as follows:

1. Can we use some fabric manipulation techniques with optical illusions to create designs that suit different types of women's body?
2. The suitability of each technique for each body type.
3. What is the best technique for all women's

body types to produce different and varied designs?

### Research objectives:

Creating a piece of clothing that can be modified in more than one way to suit each body type using illusion through fabric manipulation techniques.

### Research limitation:

Design and produce women's clothes by fabric manipulation techniques (slashed tuck - 3d origami using cutting patterns) using optical illusion concept for different woman's body types (Carrot-pear - rectangular- apple )for age group (30-40).

### Research methodology:

Research follows the descriptive analytical method and application study.

### Research tools :

A questionnaire for evaluating the design, followed by statistical analysis.

### A reversible garment

The term of reversible clothing refers to one of sustainable fashion clothes that can be worn in two ways to achieve many benefits, such as obtaining a variety of the same piece of clothing with high construction quality to withstand wear from the inside and outside; in addition to the possibility of choosing a design so it is considered eco- friendly clothes (3). They can be obtained by using:

1. Double-cloth fabrics: which are made of two fabrics threaded together to form a thicker and more substantial fabric fig (1).
2. Double-faced fabrics: these fabrics have only one layer of fabric and cannot be separated

fig (2)(4).



fig (1): Double-cloth fabrics.



Fig (2): Double-faced fabrics.

**The layered method**

Cut two of each pattern piece, with one piece in each fabric. Baste or glue baste the matching pieces to one another, with wrong sides together.

Sew the garment, using these two basted pieces as one The best option for this is a flat felled seam and bound seams or French seams fig (3).

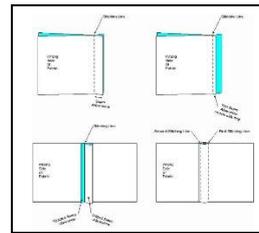


Fig (3): Flat felled seams look finished on both sides of a garment.

**The pillowcase method:**

Cut two of each pattern piece from each of your fabrics. Assemble each side of the reversible garment separately. Sew them together along all of

the edges, with right sides together, leaving a gap along one edge. Turn the entire garment out through the opening, then close the gap with a hand slipstitch (5) fig (4).



Fig (4) :Press all matching seams and darts in opposite directions, so there are fewer layers of bulk inside the garment.

**Optical Illusion**

An optical illusion is an illusion characterized by a visual perception that differs from reality optical Illusion have always been widely used in designing and selecting clothes There are different types of optical illusions which cause different results:

**1. color Illusions:**

Color illusions depend on the fact that light objects against a dark background appear larger than their actual size and vice versa due to the irradiation phenomenon as we interpret the surface color as light or dark depending on the number of rays reflected from the surface. Bright rays reflect outside their color boundaries and enter the dark spot region because there is little of their reflection, so the greater the color contrast, the more the reflected rays sweep across the empty dark region. And vice versa, and as a result, the rays reflected from the light spot occupy the dark spot and a slight halo appears to us around the

light spot, then the light area appears larger than the dark area, which is called optical. Irradiation (6). It can be obtained in the field of fashion design by dividing clothes into distinct parts with different colors, where the illusion of color destroys the shape, and thus distracts attention from problem areas in the figure, while preserving the general silhouette of the costume and thus achieving harmony in the body shape fig (5).



Fig (5): color Illusions.

There are different types of optical illusions which cause different results:

**2. Filled Extent (Helmholtz illusion & Oppel-**

**Kundt illusion):**

Helmholtz illusion which is that a square made up of vertical lines will actually appear wider and shorter than a square made up of horizontal lines

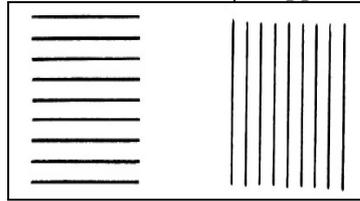
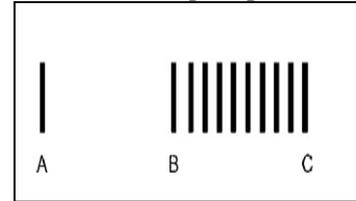


Fig (6): Helmholtz illusion

fig (6), and this is due to something called a filled extent where the shapes appear larger when filled than when they are solid (7). which is what the Oppel-Kundt illusion concept depends on fig (7).



fig(7): Oppel-Kundt illusions.

**3. Geometric illusion:**

**3-1-The illusion of angle:**

The illusion of angle, an acute angle, and obtuse angle. The distance between the sides of the acute angle appears larger than it is in reality while the distance between the sides of the obtuse angle

appears smaller than it actually is. As a result, awareness receives distorted information that the acute angle is greater than the true angle (8). This was used in clothing where the downward angles of the skirt or dress would increase the hips, and the upward angles would decrease Fig (8).



Fig (8): The illusion of angle.

**3-2 -Goering's illusion& Wundt illusion:**

Goering's illusion discovered by the German physiologist E. Goering in 1861. The two vertical lines in the figure are straight, but they look bent outwards, Distortions are created due to the background formed by lines intersecting at one point. this is will create the impression of volume

fig (9). While The opposite effect is produced by the Wundt illusion. the straight line appears concave. Distortions are created due to the background formed by lines intersecting at two points the corresponding arrangement gives some harmony to the full figure and can more clearly express the waist (8) fig (10).

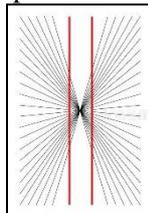
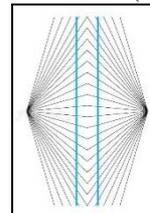


Fig (9): Goering's illusion.



Fig(10): Wundt illusion.

**3-3-The Müller-Lyer Illusion**

The Müller-Lyer Illusion is one of the most well-known illusions. It is based on two lines of the same length are perceived to be of different

lengths due to direction the linear patterns of the arrow at the beginning and end of the lines (9) fig (11).

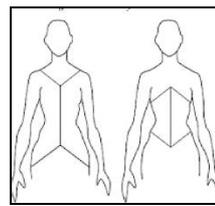
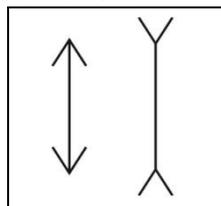


Fig (11): The Müller-Lyer Illusion

**Types of body:**

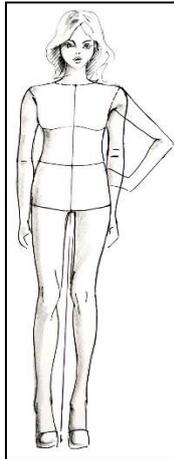
There is no standard way to determine the type of body shapes, and there are several methods for

determining body shapes, which are known as body shape calculators, some of them depend on geometric shapes or fruit shapes, and women's

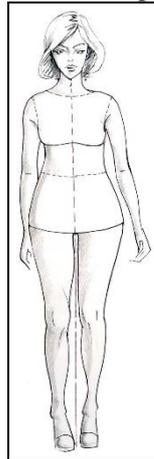


body shapes are generally divided into 5 types, which are the pear, apple, hourglass, carrot. And rectangle. Each body type has its own advantages and disadvantages that must be taken into account when choosing clothes. In this study, the researcher considered the hourglass-shaped body as standard due to the consistency of the shoulder size with the size of the buttocks (10) (11) (12).

1. **Carrot -shaped** are large at the top with a large bust and wide waist, and smaller at the bottom, with narrow thighs and legs fig (12).
2. **Pear-shaped** have slender and sloping



Fig(12): Carrot -shaped.



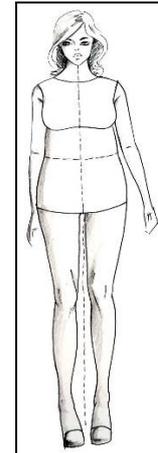
Fig(13): Pear -shaped.

shoulders and a distinctly narrow bust, while the hips and thighs are often wider and rounder fig (13).

3. **Rectangular shaped** tend to have a straight shape have shoulders and hips almost the same size but without definition at the waistline fig (14).
4. **Apple-shaped** tend to concentrated a weight around midsection and chest with rather broad shoulders, proportional hips, thinner legs and arms, and a flat bottom fig (15).



Fig(14): Rectangular -shaped.



Fig(15): Apple-shaped.

**Fabric manipulation:**

Fabric manipulation is the technique of creating 3D fabrics from a flat two-dimensional piece of fabric by adding carving and embossing effects to the fabric to create a unique feel and look. The methods of fabric manipulation varied between:

1. **Fabric texturing:** These types of fabric manipulation use the fabric, cut and style of the garment to make embellished tucks, folds, pleats, gathered frills and 3D origami tessellation.
2. **Stitching:** A garment can be embellished by additional decorative stitches, embroidery and adding trims.

3. **Bling:** use Sequins, rhinestones and beads for embellishing fabrics.

**Tuck:** tucks are folds that are stitched along. It adds texture to clothing instead of volume. It can also be stitched in different directions to add a 3d look, there are many types of tucks as (standard tucks- curved tucks –contoured tucks-shell tuck-slashed tuck- cross tuck.....).

**slashed tuck:** it is produced from standard tuck where parallel folds pulled up from the surface of fabric and held by stitching from one end to the other and repeated at equal distance, then tucks slashed into narrow loops as fig (16).



Fig (16): slashed tuck/

**3D origami tessellation with fabric using folds & repetition to create a dimensional tiled pattern:**

Fabric manipulation innovative textiles design by using Single shapes, folded then applied in patterns and tessellations. These techniques create a dense surface texture using repeating shapes in layers and rows.

1. **Origami tessellation technique:**

The designer relied on creating a tessellation from a set of shapes that fill the cloth without gaps or overlaps. The pleats are used to bind particles like twisted folds together in a repetitive way, as Nintai: geometric origami-inspired dresses, these dresses were created by designers Mercedes Arocena and Lucia Benitez who used geometric

shapes as the basis for developing these origami-inspired dresses by folding, creasing and building structures from rectangles and patterns fig (17).



Fig (17): Nintai's origami-inspired geometric dresses

### Origami using cutting patterns

The designer relied on the fabric into geometric shapes and then stitching or gluing them together to create the texture of fabric, such as the Watanabe collection in Fall 2016 with wonderful



Fig (18) Watanabe's collection on fall 2016.

shapes and colors and dazzling work style, as most of the looks are characterized by one distinctive outfit that is worn over basic narrow black pants and long-sleeved shirts fig (18).

### Method:

The researcher aims to produce clothes that can be used with all different body types through the possibility of changing the distribution of the decorative units within the design to suit each type by using the concept of the optical illusion and applying it with some fabric manipulation techniques as slashed tuck tech and 3d origami using cutting patterns tech.

So, the researcher created 24 designs produced from two inverted innovative samples relied on use two fabric manipulation techniques through the concept of optical illusion:

- Sample (A) based on slashed tuck technique.
- Sample (B) based on 3d origami using cutting patterns technique.

The experiment based on use two colors white/black color in order to obtain decorative units that can be flipped in attempt to achieve the optical illusion by dividing the clothes into parts

highlighted in white and others in black to achieve highly effect of harmony in figure.

Then the researcher implemented a simple A-line dress from each sample that could be developed and changed by manipulating the distribution of decorative units inside the dress to suit each type of Women's body, (apple shape, pear shape, oblong shape and carrot shape) separately, where 3 designs are produced for each type from each sample.

For evaluation the possibility overcoming the problems of the different Women's body types through the application of fabric manipulation through the illusion of color, the researcher conducted a questionnaire composed of 5 items as follows:

1. The structured shape of used units has aesthetic values.
2. The chosen units achieve a high level of diversity in design and application.
3. Successful of producing creative samples of reversible manipulative fabric.
4. The method of distributing units is appropriate for body type.
5. The used unite is suitable for design.

Each item assessed on 5= strongly degree, 1= strongly disagree.

The experimental works were evaluated by ten professors and assistant professors in the field of fashion design, the following is an over view of two samples of manipulation fabric techniques applied on (24) designs of simple A- dress.

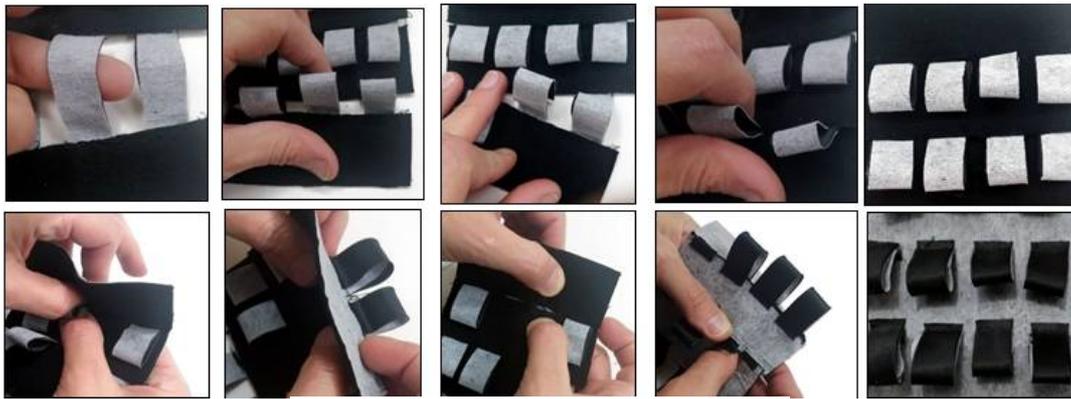
### – Sample A:

Materials: two pieces of fabric in wide horizontal stripe black/white.

Technique: slashed tuck.

### Steps:

1. Glue two layers of fabric with each black line facing a similar white line on the other side.
2. Two identical rectangular areas are emptied from one of the black or white lines, leaving similar areas between them, and this cavity is repeated in the lines of the cloth, leaving an intact line without emptying it, alternating with what was hollowed out.
3. Sew the edges of the striped areas to each other leaving the previously hollowed holes without stitching.
4. You will notice that the cloth has become on two sides, one of which is white and the other side is black except for the fringes that were formed from areas that have not been hollowed and that have the ability to highlight the opposite color on each side.
5. It is no secret that we can use the distribution of different fringes to suit each body by contrasting black and white colors fig (19).



**Fig (19): Production Stages of sample A**

**Carrot body:**

Increasing the hip width through illusion of angle where the downward angles of the dress would increase the hips as (des 1), While the downward

angles at the top of the dress reduces the shoulder width as (des 2), In (des 3), the Helmholtz illusion used through the striped lower part of the dress appears larger than the solid upper.



**Rectangle body:**

Color illusions are used in (des 4), Cut the figure at the waist in solid color thus divide the shape into 2 trapezoids instead of extending the

silhouette into a rectangle, While the shoulder width has been reduced through the black color as (des 5) unlike what appeared in (des 6) where the black color in waist area add feminine appearance.



**Apple body:**

The lines throughout the (des 7 & 8) add the feminine look to the body by defining the waist area and chest area, while (des 9) based on vertical

strip can visually reduce the width and increase the height. it makes the silhouette slim and stretches.



Des 7

Des 8

Des 9

**Pear body:**

In (des 10) The filled space in top of dress seems larger, while the illusion of angles used in (des 11) the upward angles at the top of the dress Increase

the shoulders and emphasized the chest even more, while (des 12) based on increased shoulder and chest using Helmholtz 's illusion.



Des 10

Des 11

Des 12

**– sample B:**

**Materials:** a piece of double-faced fabric black/white.

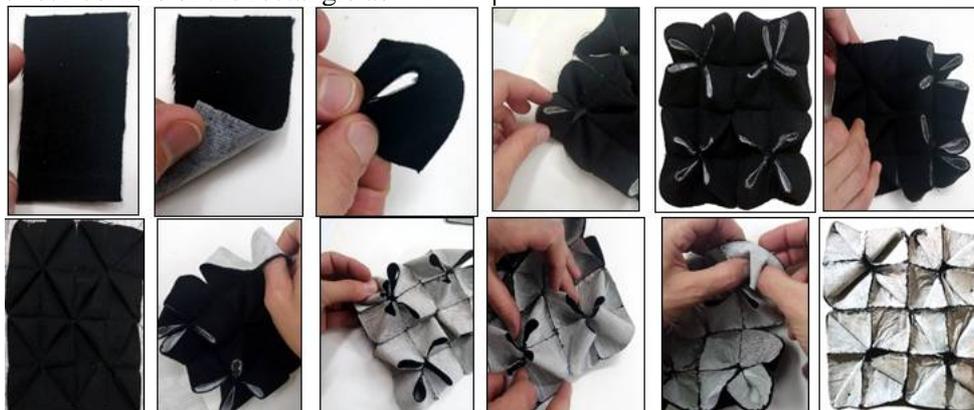
**Technique:** 3D origami using cutting patterns.

**Steps:**

1. The fabric to be used has been cut into identical rectangles. The longest side in each rectangle is equal to twice the smaller side (A B C D), where each letter of these letters symbolizes one of the four corners of the rectangle as

shown in the figure

2. The angle A is fixed to the angle D with stitches, producing a conical shape.
3. All four conical shapes were collected in the form of a rose, by stitching the short ribs to each other as in the figure
4. By repeating the unit formed in the shape of a flower, the used tissue piece is produced. Fig (20)



**Fig (20): Production Stages of sample B**

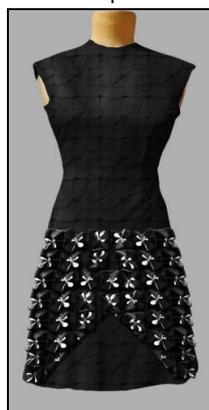
**Carrot body:**

Color illusions are used in (des 13) that the lower part of the dress looked fuller by adding white in the used units on both sides of the dress, While

The Müller-Lyre's Illusion used in (des 14), In (des 15) The filled space in upper part of dress seems large.



Des 13



Des 14



Des 15

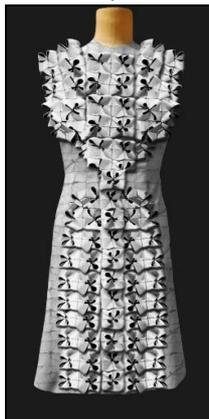
**Rectangle body:**

The filled space is used in (des 16) that the lower part of the dress looked fuller by adding 3d origami units on both sides of the dress in addition to chest area, while in (des 17) The filled space is used by adding bends with solid color in waist

area and around hip, in (des 18) the filled space is used in the lower part of the dress by adding 3d origami units on both sides of the dress and chest area so they looked fuller in addition to make bends in waist area to reduce it.



Des 16



Des 17



Des 18

**Apple body:**

In (des 19) The body appears thin due to the predominance of dark color throughout the dress and the presence of 3d origami in wide hem of the skirt hides the hips this make the lower part is too wide compared to upper part, while in (des 20) the

downward angles at the top of the dress reduces the shoulder width and vice versa in (des21) the upward angles at the lower part of the dress increase hip width, in both of them the vertical line stretched the figure to appear slimmer.



Des 19



Des 20



Des 21

**Pear body:**

The filled space is used in (des 22 & 23) that the top of the dress looked fuller by adding 3d origami units on both of them in addition to vertical line in

(des 22) stretched the figure to appear slimmer, while (des 24) the upward angles at the top of the dress Increase the shoulders and emphasized the chest even more.

**Results****Table (1): Average of every body types by technique(A) of the fabric manipulation**

	carrot body			rectangle body			apple body			pear body		
Technique	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12
A	4.60	4.45	4.65	4.20	4.00	4.30	3.60	3.80	4.00	4.85	5.00	4.90
A	4.75	4.45	4.60	4.30	4.00	4.25	3.55	3.70	3.90	5.00	4.80	4.90
A	4.60	4.50	4.45	4.20	3.85	4.20	3.55	3.85	3.70	4.80	4.85	4.80
A	4.60	4.35	4.55	4.20	3.90	4.25	3.50	3.60	3.70	4.80	4.85	4.85
A	4.65	4.50	4.65	4.35	3.95	4.10	3.40	3.60	3.85	4.95	5.00	4.90
A	4.50	4.55	4.55	4.25	3.85	4.20	3.45	3.70	3.80	4.95	5.00	5.00
A	4.55	4.35	4.60	4.30	3.90	4.25	3.60	3.55	3.65	4.80	4.90	4.90
A	4.50	4.40	4.60	4.35	3.80	4.05	3.45	3.60	3.75	4.90	4.75	4.80
A	4.60	4.50	4.50	4.20	3.85	4.20	3.50	3.80	3.80	4.80	4.80	4.75
A	4.65	4.55	4.65	4.25	3.95	4.15	3.45	3.65	3.75	4.85	4.80	4.70
MEAN	4.60	4.46	4.58	4.26	3.91	4.20	3.51	3.69	3.79	4.87	4.88	4.85

**Table (2): Average of every body types by technique (B) of the fabric manipulation**

	carrot body			rectangle body			apple body			pear body		
Technique	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24
B	5.00	4.90	4.95	4.65	4.50	4.80	4.40	4.45	4.45	4.95	4.85	4.95
B	4.95	4.80	5.00	4.70	4.45	4.75	4.40	4.45	4.45	4.85	4.90	4.90
B	4.85	4.85	4.80	4.60	4.50	4.60	4.45	4.50	4.50	4.85	4.80	4.80
B	4.95	4.85	4.85	4.55	4.45	4.70	4.55	4.50	4.50	4.85	4.80	4.85
B	5.00	4.95	4.90	4.65	4.50	4.65	4.50	4.50	4.50	4.90	4.95	4.80
B	5.00	4.90	4.95	4.60	4.55	4.70	4.55	4.55	4.55	4.90	4.95	4.95
B	4.90	4.90	4.90	4.70	4.60	4.60	4.40	4.60	4.60	4.80	4.80	4.90
B	4.95	4.85	5.00	4.60	4.65	4.75	4.45	4.55	4.40	4.80	4.80	4.80
B	4.90	4.95	4.85	4.75	4.50	4.80	4.50	4.50	4.50	4.80	4.80	4.85
B	4.85	4.90	4.85	4.65	4.55	4.65	4.45	4.55	4.55	4.75	4.85	4.80
MEAN	4.94	4.89	4.91	4.65	4.53	4.70	4.47	4.52	4.50	4.85	4.85	4.86

**Table (3): A comparison of average between the fabric manipulation techniques A&B**

tech	carrot body		rectangle body		apple body		pear body		mean
A	D1	4.60	D4	4.26	D7	3.51	D10	4.87	
	D2	4.46	D5	3.91	D8	3.69	D11	4.88	
	D3	4.58	D6	4.20	D9	3.79	D12	4.85	

	mean	4.55	mean	4.12	mean	3.66	mean	4.87	4.30
B	D13	4.94	D16	4.65	D19	4.47	D22	4.85	
	D14	4.89	D17	4.53	D20	4.52	D23	4.85	
	D15	4.91	D18	4.70	D21	4.50	D24	4.87	
	mean	4.91	mean	4.62	mean	4.49	mean	4.86	

By comparison averages in tables (3) the results indicate that:

1- The two techniques have succeeded in overcoming the appearance problems of different body types they all have a positive result and close results with slight differences where the best technique is 3D origami using cutting patterns with an average of 4.72 while slashed tuck tech has an average of 4.30.

2- Where 3D origami using cutting patterns tech was the best technique suited to carrot body type with an average of 4.91. also it was the best technique suited to rectangle body type with an average of 4.62, besides, it was the best technique suited to apple body type with an average of 4.49, while the best technique suited to pear body type was slashed tuck tech with an average of 4.87.

**Discussion:**

It was also found out through experimental work that:

1. The best way to express and enhance the feminine appearance is the 3d origami technique, and this is due to the dimensions that the Origami units can add to the body by using the whole unit or showing parts and hiding parts, also, the origami unit used has a multi-aesthetic appearance, it can be used as a trifoliate or quadruple-leaf flower or transformed into an extended line, which means a great variety in the shape of the resulting designs and a greater ability to control the shape of the designs.
2. Two techniques gave positive close results and very small differences with the pear body type, but, the best method achieved the highest results with it was slashed tuck tech This is due to it could be employed successfully and flexibly as lines or repeated to fill the spaces, and then the type problems could be overcome with simple and clear pattern lines with a great positive impact.

**Conclusion:**

It turns out through experimental work that the best way to express the feminine appearance through reversible clothing is the 3D origami using cutting patterns technique as:

- 1- Reflects the aesthetic values of the fabric manipulation unit (rose).
- 2- It enables the designer to move and control it freely and flexibly to create various designs

that suit different styles of the human body.

- 3- It allows creating multiple forms of unity without losing its aesthetic values.
- 4- The slash tuck technique has not achieved great success as 3d Origami this is due to the nature of the unit used, which adopts straight lines and angles, that makes it difficult to obtain curves which play a large role in overcoming the problems of some body types.

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