A study of the Aesthetic Patterns of the Umbilicus among Egyptians with A New Technique for Umbilical Reconstruction de novo

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ABSTRACT

Umbilicus is a key feature in the aesthetics of the abdominal wall that should be preserved in operations commonly performed to manage problems arising in this region. In this work a study of the normal shape and position of the umbilicus in normal healthy Egyptian females and best way of measurement according to the case. The most prominent points in obese persons are the anterior superior iliac spine and the xiphisternum and the easiest to be located, so should be used as points of reference. The shape of the umbilicus was found to be vertical, round or round-hooded. In all procedures done on the abdominal wall, the surgeon should put in mind attempting to preserve the umbilicus and if this is not possible as in attempting to manage large ventral hernias, a new simple technique of creating a new umbilicus is described to suit those cases.

Key words: umbilical reconstruction - umbilicoplasty

The umbilicus is an important and essential aesthetic component of the abdomen[(1)]. It has a key effect on the esthetic appearance of the abdomen. Its position in the abdominal wall, its shape and depth are important influential factors of beauty and psychological well being, which must be preserved or considered when one contemplates an abdominal reconstructive or esthetic procedure[(2)(3)].

Abdominoplasty has been one of the most popular plastic surgery procedures performed since it deals with one of the areas of the body liable to change, stretch and store fat, as well as being the one area to affect most the entire appearance of the body and trunk. It has no longer become a mere amputation of the flesh but a whole resculpture of the trunk.

Management of huge umbilical and para-umbilical hernias with or without abdominoplasty involves entailed alterations of the umbilical position in the abdomen up to its complete removal[(4)]

The Umbilicus is a fibrous cicatrix covered by adherent puckered skin lies a little below the midpoint of linea alba, below it the linea alba is narrow corresponding to the linear interval between the recti, while in the supra-umbilical portion of linea alba it is broader as the two recti diverge from each other and can be recognized on the surface as a hollow groove[(5)].

The normal position of the umbilicus has been described by most as occupying or near the midline, level with the iliac crests and approximately 2.5 cm. above maximum waist suppression[(6)(7)]. Psillakis et al had defined the waist as extending 7-10 cm between the inferior costal ribs and the iliac crests[(8)].

The umbilicus varies in position with age; in the young adult it usually lies on level with the disc between the third and fourth lumbar vertebra. As age advances, and in conditions of deficient tone of the abdominal muscles, it sinks to a lower position[(8)(9)].

A more exact location is given by Vernon who positions the umbilicus two to four cm below the waistline – though this is also an inexact measurement intraoperatively[(10)]. Hinderer gives a method for locating it – 3 cm above the level of the anterior iliac crest[(11)]. In a study done on 100 non-obese subjects, Dubou & Ousterhout found that in 96 percent of the subjects the horizontal level of the umbilicus coincided with the topmost level of the iliac crest.. Obesity would obviously affect this relationship. This position appeared to be confirmed both by drawings in the standard art textbooks and by a brief review of classic art objects. Though not emphasizing this relationship, the works of da Vinci, Albini and Vesalius appeared to be consistent with this finding[(12)].

Although the ideal shape of the umbilicus has been debated, recent studies have shown the young thin female with an attractive abdomen tends to have a small, vertically oriented umbilicus[(13)]. There is a tendency for variation with age as depicted by Psillakis et al. It is generally flat and vertical in young individuals and later develops hooding and deepening of the stalk as fat accumulates along the deep fat pocket that surrounds the umbilicus[(8)]. A transverse orientation usually occurs after childbirth; however ageing in contribution with weight gain will contribute to a deeper umbilical stalk and an overall widened appearance[(14)]. Other shapes have

been described, namely the rounded or the transversely oriented umbilicus. It may be hooded or not. It may be inverted showing a deep crater in obese subjects, or shallow with its base level at the surface in thinner individuals[12].

A wide and deep umbilicus and an exceedingly small umbilicus are considered unattractive. The presence of outward protrusion also called An "outie" is also considered unappealing[14][15][16]. Desirable characteristics are small size, vertical orientation and the presence of a superior hood, which is thought to add a youthful appearance to the abdomen [16][17].

*M*assiha *et al* describes variations of the appearance of the umbilicus with different body types in his paper for umbilicoplasty. For example, in a corpulent patient with excess subcutaneous fat, the umbilicus has a crater of skin going down to the level of skin of the umbilicus proper that in turn is held down by its attachment to linea alba. In a thin athletic person, this crater is shallow and the base of the umbilicus can be seen. However, if no scars are present around it, the umbilicus still has a pleasant appearance[2].

In a study on the ideal female umbilicus, Craig conducted a photographic analysis of the umbilicus in 147 women to ascertain the characteristics of an ideal umbilicus to be used for umbilicoplasty. In his study population, the most common shape was the t-shaped, followed by the oval, vertical, transverse and distorted shapes respectively. The majority demonstrated a superior hood, and possessed a small umbilicus without protrusion. Those women who were heavier tended to have a larger, more transversely oriented umbilicus, whereas the umbilici in thinner individuals had a more vertical orientation. Umbilical protrusion was unappealing, and a large umbilicus had a strong negative aesthetic influence, while hooding had a positive one. These data suggest that the most esthetically pleasing umbilicus is small in size, vertical in shape, and possesses a superior hood or shelf. Unappealing characteristics included a large size, a horizontal or distorted shape and the presence of umbilical protrusion (an "outie")[14][16].

Over the past decades many trchniques have been described to reconstruct the umbilicus concealing sutures of umbilical reconstruction deep within the depths of the umbilical crater to achieve the least conspicuous scars and the most natural-looking umbilicus. These descriptions of umbilicoplasty de novo all depend on creating diiferent designs of defattened skin flaps to be sutured to the linea alba including: the Iris technique[17], the four dermal flap technique [18], the double Z-plasty and the tri-leafed flap[3], the triangular star incision[2] , the Iida technique[19], the purse string technique[20], the double M-Incision[21], the double half-cone flap umbilicoplasty [22], the fan flaps[23][24], and the lazy-M and Omega flaps[25].

PATIENTS AND METHODS

The study Inolved 2 parts; the first part was an anatomical study to evaluate the position and shape of the umbilicus in normal young healthy persons., the second part was the assessment of a new technique of umbilicoplasty (reconstruction of the umbilicus in cases of large umbilical and para-umbilical hernias.

The anatomical study of the normal subjects included forty Egyptian persons who volunteered to conduct this study; twenty females and twenty males, their ages ranged from eighteen to thirty years with average age of 23.75 in males and 23.15 in females. All of them were of average weight to height ratio, of a BMI of 21 to 26, average BMI 23.15 in females and 23.75 in males. They were physically examined to exclude abdominal conditions that may change the position of the umbilicus such as intra abdominal swellings, hernias or previous pregnancy or previous surgery.

The measurements were taken as distances between the following points and the umbilicus:

1. xiphisternum (XU)
2. midpoint of upper border symphysis pubis (Sym-U)
3. right anterior superior iliac spine (RtASIS-U)
4. left anterior superior iliac spine (LtASIS-U)
5. highest point of iliac crest (C-U)

- All measurements were taken first in the standing then in the recumbent position, with the patient properly centralized with no pelvic tilt, and lying supine without a pillow.
- Vertical and transverse diameters of the umbilicus were measured, and its depth was measured using a rigid wooden rod, inserted, marked and drawn out.
- The shape of the umbilicus whether vertical or transverse or rounded was noted, as well as the presence or absence of a superior hood and depth of the umbilicus. Photographs of all subjects with abdomen naked were taken to document the findings.
- Measuring the position of the umbilicus was done as in normal persons and the shape was documented.
- A statistical evaluation of the results of measurements was done to show the average, standard deviation and a t student test was done to evaluate the significance of differences of measurements in the standing and lying down positions.

The second part of the study included the reconstruction of the umbilicus in the **sixteen** cases of large ventral hernias during hernipoplasty together with an abdominoplasty; 16 patients had ventral hernia: 7 para-umbilical hernias, 6 incisional hernias and 3 recurrent incisional hernias. The three recurrent incisional hernia patients had the umbilicus previously removed. The size of the defect was between one and three fingers in width in 5 cases and was more than three fingers in width in 11 cases. They all underwent abdominoplasty with umbilical reconstruction (umbilicoplasty) after repair of the hernia with a mesh in 13 cases and without a mesh in 3 cases.

The umbilicoplasty technique used involved the design of a u-shaped flap of skin pointing upwards and a longitudinal 1.5-cm incision perpendicular and superior to it and connected to its apex. The flaps were then defattened and sutured down to the rectus fascia leaving a small circular raw area in the rectus fascia to granulate and scar. A tie over suture over a vaseline gauze is applied and removed after a week.

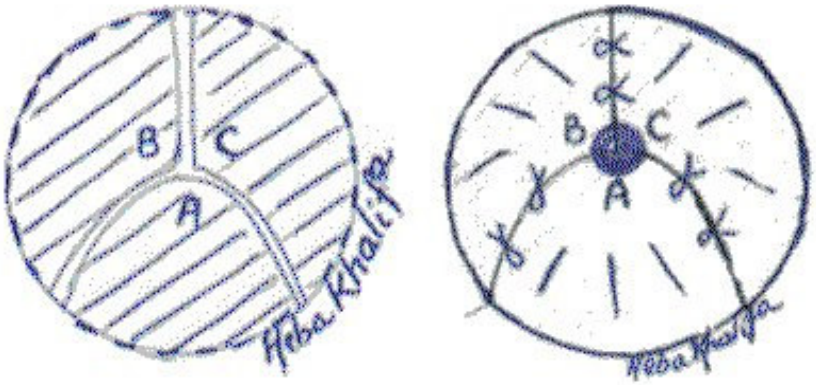


Fig 1: Left: Area of defatting below the three flaps. Right: Raw area in the middle, left to granulate

In cases of umbilicoplasty over a mesh, an underlying circular area 5-cm in diameter of the mesh was removed at the site of umbilicoplasty to avoid possible exposure and infection of the mesh in case of umbilicoplasty complication.

Results were judged as **excellent** if the following criteria were present:
*Proper positioning of the umbilicus *Normal shape and size
*Presence of depth * Scar within the umbilicus not at the edge

Satisfactory results criteria were:
*Good position *Depth shallower than normal
*Size smaller or larger than desired

Unsatisfactory results presented as follows:
*Loss of depth *Too small umbilicus (umbilical stenosis)

*Malposition *Scar visible

All cases were followed up at periods of one month, three months, six months and one year. At follow-up visits, umbilicoplasty was evaluated for shape, size and depth and visibility of scar. Evaluation of possible recurrence of the ventral hernia was done.

RESULTS

The results of measurements taken to determine the position of the umbilicus in 20 normal female subjects were as follows:

The average distance from xiphisternum to the umbilicus was 17.5 cm with a standard deviation (SD) of ±1.87 in the standing position and 18.9 cm in the recumbant position with SD of ±1.75. The average distance from the midpoint of symphysis pubis to the umbilicus was 14.6 cm standing with SD ±1.20 and 14 cm recumbent with SD ±1.02. The average distance from the anterior superior iliac spine to the umbilicus on the right side was 15.2 cm standing with SD ±1.178 and 14.8 cm recumbent with SD ±1.077, and on the left it was 15.7 cm standing with SD ±1.054 and 14.8 cm recumbent with SD ±1.077.

The shape of the umbilicus in the female subjects was rounded in 10 cases (50 %), with average depth of 2.5 cm and average diameter 3 cm. It was found to be rounded hooded superiorly in 3 cases (15 %) and vertical in 7 cases (35 %) with depth 1.5 cm and diameters 1X2 cm on average.

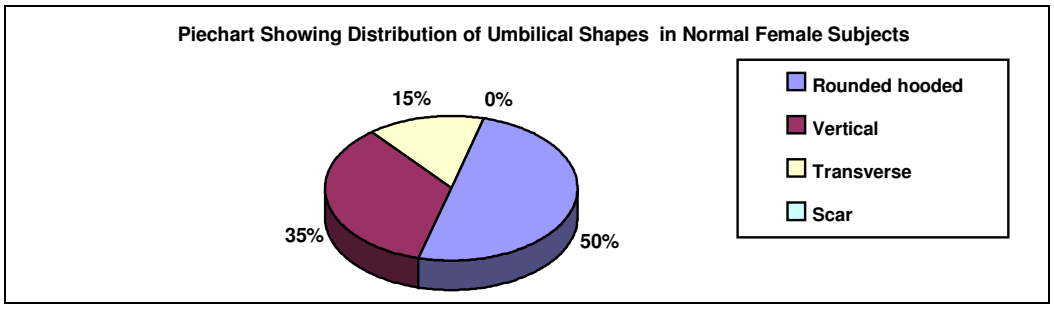


Fig. (2)

Subject	Age	Height	Weight	Standing				Recumbant			
				Xiph.	Symph.	Rt. ASIS	Lt. ASIS	Xiph.	Symph.	Rt. ASIS	Lt. ASIS
1	20	157	55	16	15	16	17	18	15	15	16
2	23	168	65	17	15	16	16	19	14	15	15
3	19	160	65	17	14	16	16	17	14	16	16
4	20	170	63	22	15	16	16	22	15	14	14
5	20	166	62	17	17	16	16	21	16	17	13
6	21	173	63	18	13	15	15	21	14	14	14
7	21	168	55	20	15	15	15	18	13	14	13
8	20	158	59	16	14	17	17	16	13	13	16
9	21	170	58	16	12	14	14	17	12	15	14
10	20	165	80	19	17	18	18	23	15	17	17
11	21	156	56	15	14	14	14	18	14	13	15
12	21	156	59	14	14	16	16	17	13	15	16
13	28	163	53	19	15	14	14	19	14	14	14
14	27	170	58	18	15	15	16	20	15	15	15
15	29	168	68	18	15	15	16	20	15	15	15
16	29	170	75	18	15	15	16	19	15	15	15
17	29	165	60	18	16	16	17	19	15	16	16
18	30	169	70	18	13	13	15	19	13	15	14
19	21	173	70	17	14	14	15	18	13	14	14
20	22	167	57	17	14	14	15	18	13	14	14
Mean				17.5	14.6	15.2	15.7	18.9	14.0	14.8	14.8
SD				1.87	1.2	1.18	1.05	1.746	1.02	1.08	1.08

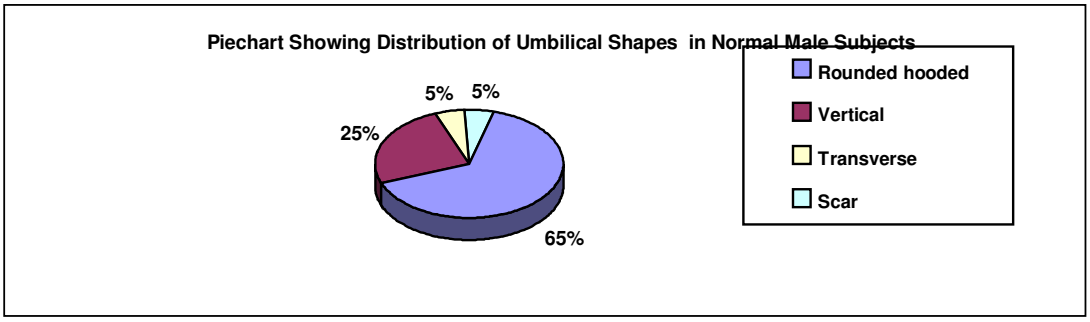
Table 1: Normal Female Values

Fig.(3) left: Vertical umbilicus in normal female. Right: Vertical hooded umbilicus in normal female.

Subject	Shape of umbilicus	Distance from iliac crest	Dimensions		
			Transverse	Longitudinal	Depth
1	Round hooded	2	3	3	2.5
2	Round hooded	2	3	3	2.5
3	Vertical	3	1	1	1
4	Round hooded	2	3	3	2.5
5	Round hooded	1	3	3	2.5
6	Round hooded	4	3	3	2.5
7	Vertical	1	1.5	2	2.5
8	Round hooded	3	3.5	3.5	3
9	Vertical	2	1.5	4	3
10	Round hooded	1	3.5	3.5	3
11	Round hooded	2	2.5	2.5	2
12	Round hooded	3	2.5	2.5	2
13	Vertical	1	1	2	1
14	Round hooded	2	5	5	4
15	Round hooded	3	5	5	4
16	Round hooded	3	2	2	1
17	Round hooded	3	2	2	1
18	Vertical	2	1	2	1
19	Vertical	2	0,5	2	1
20	Vertical	2	0,5	1	1

Table (2) Findings of normal umbilicus in females

The results of measurements taken to determine the position of the umbilicus in 20 normal male subjects were as follows:
The average distance from xiphisternum to the umbilicus was 17.7 cm in the standing position with SD 2.15 cm, and 18.8 cm in the recumbant position with SD 1.72 cm. The average distance from the midpoint of symphysis pubis to the umbilicus was 16.2cm standing with SD ±3.07 cm and 16.4cm recumbent with SD ±1.19 cm. The average distance from the anterior superior iliac spine to the umbilicus on the right side was 15.9cm standing with SD ±0.88 cm and 15.2cm recumbent with SD ±0.812 cm, and on the left it was 16.1cm standing with SD ±4.828 cm and 15.1cm recumbent with SD ±0.853cm.
A shallow rounded hooded umbilicus with a central mamelon (an "outie") was found in 13 males with average depth 0.2 cm, and average diameter 1.5 cm. A vertically oriented umbilicus was found in 5 subjects with average depth 0.5 cm and average diameters 0.8 X 1.2 cm. 1 subject had a transverse shaped umbilicus with a depth of 3cm and diameter 3 cm. 1 male had a natural scar in place of umbilicus with no depth and about 1 cm in diameter. The average distance above midpoint of iliac crests of the umbilicus in males was 3.5 cm.



Subject	Age	Height	Weight	Standing				Recumbant			
				Xiph.	Symph.	Rt. ASIS	Lt. ASIS	Xiph	Symph.	Rt. ASIS	Lt. ASIS
1	25	180	85	17	17	15	16	20	18	14	15
2	24	168	70	19	17	14	15	20	17	15	15
3	23	170	65	20	17	16	15	20	18	15	15
4	23	175	75	14	16	16	16	15	16	15	15
5	21	170	75	19	17	17	17	21	18	16	16
6	22	170	70	17	16	15	15	20	17	14	14
7	23	170	66	20	14	16	15	20	13	15	14
8	23	175	70	15	18	16	17	16	17	15	15
9	22	170	65	15	15	16	15	17	15	15	14
10	21	170	70	19	16	18	17	18	15	17	16
11	23	185	85	21	18	17	17	21	17	17	17
12	24	185	85	22	16	17	17	21	16	16	17
13	17	185	73	16	14	15	15	18	15	15	15
14	17	185	73	14	16	15	14	16	16	14	14
15	25	175	73	17	16	16	17	18	16	15	15
16	26	178	75	18	16	16	17	18	16	15	15
17	29	175	73	18	17	16	16	19	16	15	15
18	30	170	74	17	16	16	17	19	16	15	15
19	29	174	78	18	17	15	16	19	17	15	15
20	28	170	65	18	16	16	18	20	17	16	16
Mean				17.7	16.2	15.9	16.1	18.8	16.4	15.2	15.1
SD				2.15	3.07	0.88	4.83	1.72	1.19	0.81	0.85

Table (3) Normal Male Values

Patient	Shape of umbilicus	Distance from iliac crest	Dimensions		
			Transverse	Longitudinal	Depth
1	Round hooded	3.5	1.5	1.5	0.2
2	Vertical	4	0.7	1.2	0.5
3	Rounded	1	3.5	3.5	4
4	Rounded	1	3	3	3.5
5	Vertical	3	0.5	1	0,5
6	Vertical	4	1	1.5	0.5
7	Vertical	3.5	0.5	1	0.5
8	Round hooded	3	1	1	0.2
9	Round hooded	3	1	1	0.1
10	Round hooded	3	2	2	0.2
11	Round hooded	3.5	2	2	0.1
12	Round hooded	3.5	1	1	0.1
13	Round hooded	3.5	2	2	0.2
14	Round hooded	4	1	1	0.1
15	Round hooded	4	2	2	0.2
16	Round hooded	4	1.5	1.5	0.1
17	Round hooded	3	1	1	0.1
18	Round hooded	3.5	1.5	1.5	0.1
19	Round hooded	3	2	2	0.1
20	Round hooded	4	1.5	1.5	0.1

Table (4) Findings of normal umbilicus in males

Fig. (5) Left: Normal male, rounded umbilicus
Right: Transverse umbilicus in a normal male

Fig. (6) Marking of points of reference for measurement of the umbilicus; note the vertical configuration of the umbilicus

Survival						Total
Excellent		Satisfactory		Unsatisfactory		
7	43.75 %	7	43.75 %	2	12.5%	16

Table (5) Evaluation of Umbilical Reconstruction results.

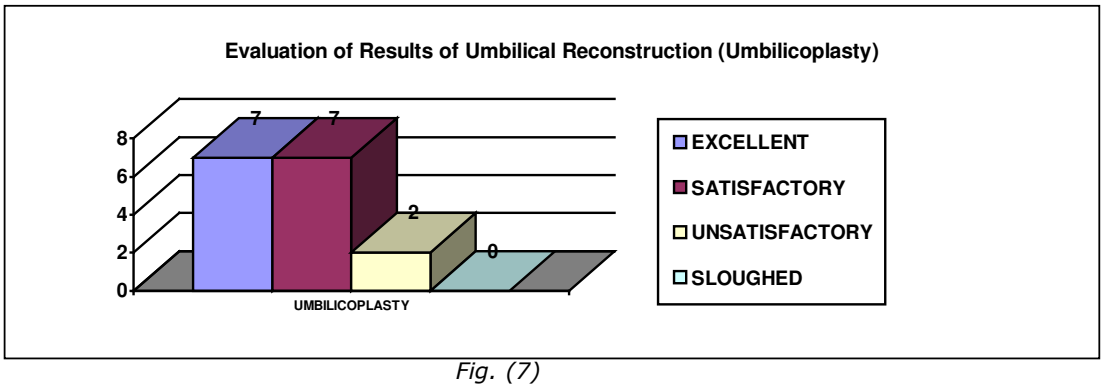


Fig. (7)

In the 16 patients where umbilicoplasty was performed the results were excellent in 7 cases as they showed adequate depth, this being the main complication of umbilicoplasty: and satisfactory in another 7 which showed some lack of depth. Unsatisfactory result was obtained in two cases which showed a loss of depth resulting in a scar on the anterior abdominal wall with no umbilical depth.

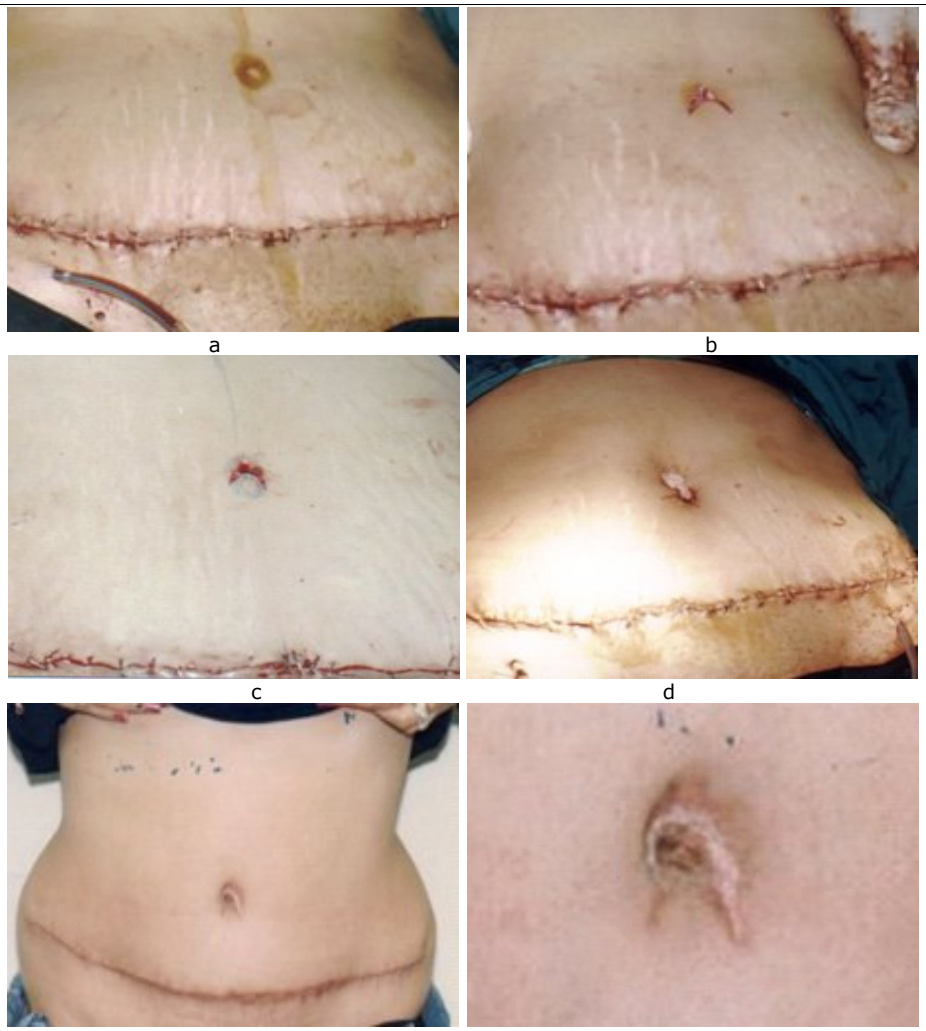


Fig. (8) A) Location of new umbilicus B-C) umbilicoplasty design & incision D) Tie-over at end of surgery E) late postoperative result F) Close up of late postoperative result

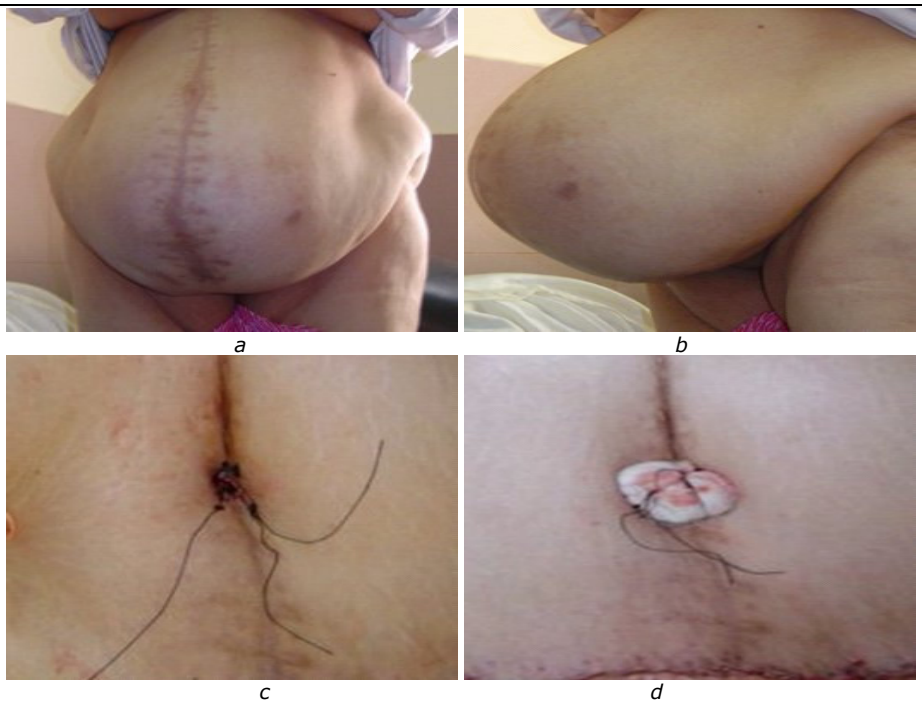


Fig. (11) A- B) Patient with incisional hernia; front and lateral views C) Umbilicoplasty de novo using the three flap technique after abdominoplasty D) After tie over and wound closure

a b

c

Fig (12) A) Preoperative view No umbilicus, for reconstruction
(B) Preoperative view design (C) Postoperative reconstruction of the umbilicus

DISCUSSION

The umbilicus is an anatomical and esthetic landmark in the middle of the abdomen. Modern plastic surgery of the abdominal wall is usually concerned with preservation of this landmark to achieve the best esthetic results. Preserving the umbilicus could be reached either by transposition or creation of a new umbilicus in cases with large hernias where the umbilicus is sacrificed to ensure proper hernial repair .

In this work an anatomical study of the position, shape and dimensions of the umbilicus in normal Egyptian male and female volunteers of young age was done and different methods to locate the position of the umbilicus were evaluated.

The aim of this anatomical study is to better understand the anatomical features of the umbilicus so as to help better reproduction of an umbilicus of normal position, shape, dimensions and appearance during surgery of the abdominal wall.

There was debate between various authors about the position of the umbilicus. Most agreed that it was somewhere midway between the xiphisternum and the symphysis some stating it was between L3 and L4[(26)], and others believed it was at the level of the iliac crests[(12)(15)], or 3 cm above the level of highest point of iliac crests[(11)], or 2-4 cm below the waistline[(10)].

We found that there was a normal range for the position of the umbilicus and that it was seldom found stark midpoint in the normal population. The normal umbilicus is found anywhere between two horizontal lines 2 cm above and 1 cm below the highest points of iliac crests respectively, and two vertical lines 1cm on either side of the midline. A shift downward from the vertical midpoint is commoner in females while an umbilicus higher than midway is seen more often in young males.

In this study it was found that the location of the umbilicus is at an average distance of 17.5 cm from the xiphoid process and about 14.5 cm from the midpoint of upper border of the symphysis pubis in both males and females which gives a proportion of about 55% to 45%.

Psillakis et al mentions a distance of 14 cm from the upper border of symphysis pubis which correlates closely with our findings[(8)].

Normal males and females in our study showed four forms of umbilical shapes; rounded, rounded hooded superiorly, vertical and transverse which was found only in obese patients and in only 1 non obese male subject.

In a pendulous abdomen the umbilicus was found to be 50% transverse (probably with an abdomen that is more lax) and 50% vertical, with the slit length in either case reaching up to 4 cm.

Measurement in obese persons with class IV abdomen (Matarasso classification)[27] undergoing abdominoplasty has demonstrated a downward shift of the umbilicus in all cases. The average distance from symphysis pubis was 21 cm whereas in normal subjects it was 14.5 cm. The average from xiphisternum in obese people was 28 cm compared to 17.5 cm in normal people.

This information obtained from the anatomical study has been clinically applied on 20 patients undergoing either abdominoplasty for esthetic reasons or in conjunction with the repair of ventral hernias of various sizes.

The key point for achieving a good esthetic result for the umbilicus is relocating it at a proper position. The ideal position for the umbilicus is ill defined and subjectively judged.

To locate the umbilicus measurements were taken from the xiphoid process, the middle of upper border of symphysis pubis and the two anterior superior iliac spines (ASIS). In addition, the location of the umbilicus was measured in relation to the upper border of iliac. It was found that measuring the distance from symphysis pubis to umbilicus is difficult and inaccurate in obese patients. Similar difficulties were encountered in locating the upper border of iliac crest.

In this study, we found it is always possible to accurately locate the ASIS even in obese people. In addition, relocating the site of the umbilicus depending on the measurement of the two ASIS was found to be more reliable than measuring from the upper border of symphysis pubis and iliac crest due to the following reasons:

The measurement of both ASIS helps to avoid lateral shift of the umbilicus.

These measurements could be accurately done while reflecting the panniculus during abdominoplasty. This is difficult to do from xiphoid and iliac crest. The advantage of locating the umbilicus while the pannniculus is elevated is to help to evaluate the plication of the aponeurosis, an asymmetrical plication may lead to shift of the umbilicus to one side. This may be particularly useful during plication of abdominal wall in post mastectomy reconstruction with TRAM.

After closure of the skin relocation of the site of the incision for a new umbilicus is best judged by locating it at the point junction of three measurement lines, the one from the xiphoid process and the two from the ASIS. The meeting point of these three lines is the most accurate method of locating the position of the new umbilicus.

According to present study, it is important to take preoperative measurements of the position while patient is lying down as it was found that measurements from the xiphoid to the umbilicus change by a range of 1 to 3 cm difference on lying down in normal subjects and up to 9 cm in abdominoplasty group. So if measurements were taken while the patient is standing and applied during surgery while the patient is lying down, the site of the umbilicus will be higher than the normal position.

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It should still be noted that measuring the umbilicus from ASIS, a shift of one cm to either side of the midline might be noted in normal persons. This was predominantly on the left rather than on the right side.

In this study it was found that the most common shape of the umbilicus is rounded in males and females followed by vertical slit.

In case the umbilicus has to be removed to deal with the ventral hernia, a technique of umbilicoplasty should be applied. Various techniques for umbilicoplasty have been described[2][3][19][13][17][28][29][30][31], all aiming at producing a normal pleasant appearance as well as good depth.

In this work a simple technique is described with 7 excellent and 7 satisfactory results out of 8 cases (87.5% good result).

The results obtained from this work should encourage all surgeons to always reproduce an umbilicus in cases of abdominoplasty with ventral hernia as the technique is simple, reliable, with low rate of complications and does not interfere with hernia repair or cause

recurrence.males was done. Different ways of measuring the position of the umbilicus were suggested so as to assist the surgeon to choose the

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