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Using Tallquist Haemoglobin Scale for Estimating Intraoperative Blood Loss in Liposuction

Ahmed Abdelmoez Alsayed

Independent Researcher, Al-Hokail, Khobar, KSA
Email: az971986@gmail.com

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Abstract

Introduction: Intraoperative blood loss remains as a concern for all surgeons. Proper estimation of intraoperative blood loss is critical and can be challenging, especially if the blood is mixed with other fluids such as tumescent fluid in liposuction cases. In such cases, proper estimation of intraoperative blood loss will lead to fewer mistakes in fluid resuscitation. In this article, Tallquist Haemoglobin Scale was tried to estimate intraoperative blood loss in liposuction. **Objectives:** Proper estimation of intraoperative blood loss in liposuction cases. **Method:** Tallquist Haemoglobin Scale will be tried to estimate the approximate intraoperative blood loss in liposuction cases using a mathematical formula that considers total fluid loss, patient's preoperative haemoglobin and the reading from Tallquist kit. **Results:** Tallquist Haemoglobin Scale can be considered as a valid method for proper estimation of intraoperative blood loss in liposuction cases, the thing that will lead to correct fluid resuscitation and fewer complications. **Conclusion:** Proper estimation of intraoperative blood loss leads to fewer mistakes in fluid resuscitation and fewer related complications of under or overcorrection. Tallquist Haemoglobin scale is a trusted, cheap and fast method for proper estimation of intraoperative blood loss in liposuction cases.

Keywords

Tallquist, Haemoglobin, Scale, Blood Loss, Super Wet, Liposuction, Tumescent, Fluid, Resuscitation

1. Introduction

Intraoperative blood loss remains as a concern for all surgeons. Proper estimation of intraoperative blood loss is critical and can be challenging, especially if the blood is mixed with other fluids such as tumescent fluid in liposuction cases. In such cases, proper estimation of intraoperative blood loss will lead to fewer mistakes in fluid resuscitation and protecting patients from under or over fluid balance correction.

To understand fluid balance in liposuction cases, two definitions should be covered:

1) Intraoperative fluid ratio 8: defined as the volume of super-wet solution and intraoperative intravenous fluid divided by the aspiration volume.

Trott et al., stated that it should be 2.1 for small-volume (aspirate < 4000 cc) and 1.4 for large-volume (aspirate > 4000 cc) [1].

Rohrich et al., revised the ratio to be 1.8 for the small-volume reductions (aspirate < 5000 cc) and 1.2 for the large-volume reductions (aspirate > 5000 cc) [2].

2) Final residual fluid volume: all intakes and outputs should be meticulously measured as follows: residual fluid volume = (total fluid volume in) − (total volume out); total fluid volume in = (total fluid volume of wetting solution used) + (total volume of IV fluid used) + (volume of bupivacaine/steroid solution); and total volume out = [total volume of aspirated wetting solution (which is approximately 30% of the total aspirated volume in most cases)] + urine output [3].

The average residual volume by ***Wang et al.*** [3] was around 110 mL/kg, and was 120 mL/kg in the report of ***Commons et al.*** [4].

IV fluid infused intraoperatively should equal:

1) Fasting deficit: hourly maintenance*number of fasting hours.

2) Hourly maintenance: body weight + 40 ml/hour.

3) Estimated fluid loss from surgical trauma: 4 - 6 mL/kg/hr. (liposuction was considered as a moderate surgical trauma) [5].

In 1996, ***Trott et al.*** suggested guidelines for intraoperative fluid resuscitation. Patients having less than 4000 cc of lipoaspirate removed received maintenance fluid only, whereas those having more than 4000 cc of lipoaspirate removed received maintenance plus 0.25 cc of intravenous fluid for each milliliter aspirated over 4000 cc [1].

To limit the degree of fluid overloading and possibility of pulmonary edema, ***Rohrich et al.*** modified the replacement fluid delivery at 0.25 cc of intravenous fluid for each milliliter aspirated over 5000 cc [2].

Although blood loss in super wet liposuction is supposed to be 1% of the aspirate [6], it is possible to exceed that percentage in some occasions e.g. technical issues, coagulopathy, etc. I recommend replacing the estimated blood loss with colloids in 1:1 ratio [7], unless one of the blood transfusion indications is met.

As a fast review of blood transfusion indications, World Health Organization (WHO) defined them, in adults, as one of the following:

1) Perioperative transfusion: 8 g/dL for patient undergoing major surgery or experiencing GIT bleeding.

2) Acute blood loss: 30% of volume of blood.

considering that One unit of whole blood/packed red blood cells can increase haemoglobin by 1g/dL in an adult or haematocrit by 3% (haemoglobin of unit must be >75%) [8].

National Institute for Health and Care Excellence (NICE) guidelines mention that when using a restrictive red blood cell transfusion threshold, consider a threshold of 70 g/liter and a haemoglobin concentration target of 70 - 90 g/liter after transfusion.

Restrictive red blood cell transfusion thresholds are for patients who need red blood cell transfusions and who do not:

- have major haemorrhage or
- have acute coronary syndrome or
- need regular blood transfusions for chronic anaemia [9].

In literature, several methods of estimating haemoglobin can be found. Direct cyanmethaemoglobin method has been the gold standard for haemoglobin estimation but other methods like haemoglobin color scale, Sahli technique, Lovibond-Drabkin technique, Tallquist technique, copper-sulfate method, HemoCue and automated haematology analyzers are also available [10].

In my opinion, two points had to be considered before choosing the haemoglobin estimation method:

1) The method should be manual, simple, fast without need for power supply.

2) The method should be able to detect very low concentrations of haemoglobin as we are trying to estimate the fraction/percentage of blood in a fluid not to estimate haemoglobin concentration in a proper blood sample.

For both of the considerations above, digital devices are not the best choice for the task. I chose Tallquist haemoglobin scale as a method (**Figure 1**).

The use of the Tallquist method in assessing anemia is of, relatively, high validity and diagnostic accuracy. Tallquist method should be an effective method to detect mild to moderate anemia in a reliable manner comparable to other standard methods such as the haematocrit and haemoglobin cyanide methods [12].

2. Methods

1) After finishing liposuction, super wet in our case, the aspirated fluid volume (V_F) is to be calculated, 400 cc in our example here (**Figure 2**).

2) Take a drop of the aspirated fluid and apply it on one filter paper, comes with Tallquist kit, wait till glistening disappears and compare it, before it completely dries, with the different color grades on the scale. The closest in our example was 4.7 g/dl (fluid haemoglobin concentration) (Hb_F) (**Figure 3**). Percentages on the scale indicate the ratio of the sample haemoglobin to a standardized sample of 15.6 g/dl haemoglobin. Do not use percentages in calculations not to get mixed with Hematocrit values.

3) Go back to the patient's preoperative investigations and get the haemoglobin value (Hb_P) (**Table 1**) (13.6 g/dl in our case).

Figure 1. Tallquist haemoglobin scale [11].

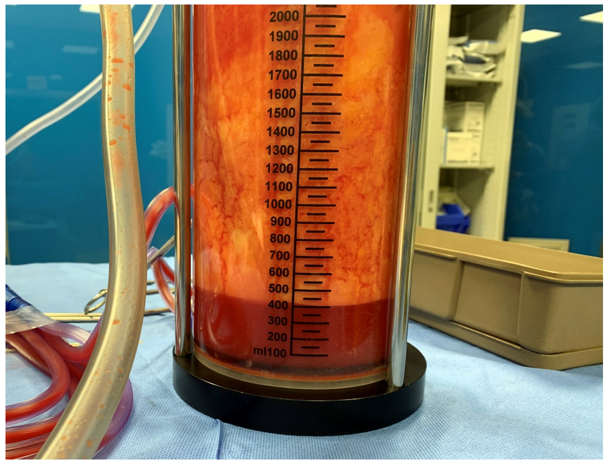

Figure 2. The aspirated fluid volume (V_F) (400 cc in our example).

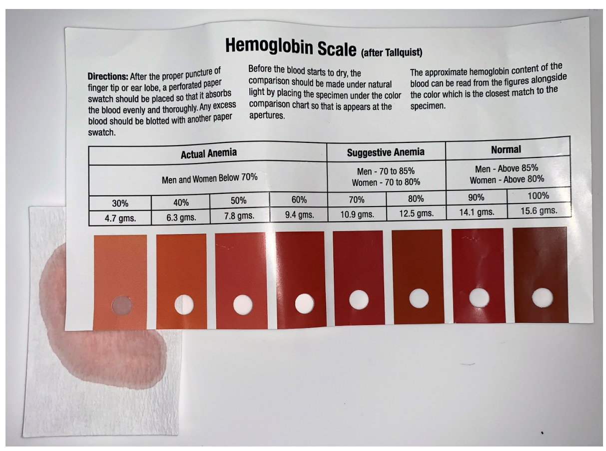

Figure 3. Take a drop of the aspirated fluid and apply it on one filter paper, comes with Tallquist kit, wait till glistening disappears and compare it, before it completely dries, with the different color grades on the scale. The closest in our example was 4.7 g/dl (Hb_F).

Table 1. Example patient's preoperative investigations: Haemoglobin concentration (Hb_P).

Complete Blood Count (CBC)			
Test	Result	Unit	Reference Range
Haemoglobin (Hb)	13.6	g/dl	12.0 - 15.0

4) Calculate the volume of intraoperative blood loss (V_L) through applying the classic concentration/volume formula (C1V1 = C2V2)

$$\begin{aligned} &\text{Preoperativepatient's haemoglibin concentration}(\text{HbP}) \\ &\times \text{Volume of intraoperative blood loss}(\text{VL}) \\ &= \text{Aspirated fluid haemoglobin concentration}(\text{HbF}) \\ &\times \text{Volume of Total aspirated fluid}(\text{VF}) \end{aligned},$$

and as a result,

$$V_L = Hb_F * V_F / Hb_P = 4.7 * 400/13.6 = 138\text{cc}$$

3. Results

Tallquist Haemoglobin Scale can be considered as a valid method for proper estimation of intraoperative blood loss in liposuction cases using a mathematical formula that considers total fluid loss, patient's preoperative haemoglobin and the reading from Tallquist kit, the thing that will lead to correct fluid resuscitation and fewer complications.

4. Discussion and Conclusion

Proper estimation of intraoperative blood loss will lead to fewer mistakes in fluid resuscitation, using crystalloids, colloids or blood, and protecting patients from under or over fluid balance correction. Application of the mentioned method can be expanded to be used in other surgeries with further blood loss. Tallquist Haemoglobin Scale can be considered as a valid method for proper estimation of intraoperative blood loss in liposuction cases. A classic mathematical formula that addresses volume and concentration of both pure patient's blood and the aspirated fluid can be applied to detect the approximate intraoperative blood loss. Blood loss from the postoperative oozing should be considered as a next target for analysis.

Data Availability

The author confirms that the data supporting the findings of this study are available within the article.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Applying Average Anthropometric Reference Measurements to Thigh Lift Surgical Design in Females: A Novel Technique

Ahmed Abdelmoez Alsayed

Independent Researcher, Khobar, KSA
Email: az971986@gmail.com

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Abstract

Background: Thigh lift is a common procedure in plastic surgery. Surgeon's sense or tailor tacdundancy to bek is mainly the methods used for designing thigh lift currently. This article is an attempt to find a method/a reference point to define the exact amount of re excised. **Introduction:** Anthropometry reference measurements can be applied in designing thigh lift surgery. Classically, anthropometry binds the calf circumference with mid-thigh circumference and upper thigh (gluteal) circumference to make postoperative results more harmonious and natural. **Method:** To find out the anthropometrically referenced ratio of the calf circumference with mid-thigh circumference and upper thigh (gluteal) circumference, anthropometric databases and studies done on females addressing different ages, countries and races with average BMI (body mass index) were reviewed. Chosen studies should include the calf circumference, mid-thigh circumference and/or upper thigh (gluteal) circumference. Anthropometrically referenced upper and mid-thigh circumferences can be calculated preoperatively. **Result:** 64:92:100 was concluded as a pooled mean ratio out of nine different studies addressing the ratio of the calf circumference:mid-thigh circumference:upper thigh (gluteal) circumference. **Conclusion:** Postoperative anthropometrically referenced mid and upper thigh circumferences can be calculated by measuring the calf circumference and applying the 64:92:100 ratio. Markings are done intraoperatively using my innovated "Stab-Push-Pinch-Mark" or SPPM technique for drawing a rough surgical design, then tweaked using the anthropometrically referenced 64:92:100 ratio results.

Keywords

Anthropometry, Anthropometric Ratio, Thigh Lift, Calf Circumference, Mid-Thigh Circumference, Upper Thigh Circumference, Gluteal Circumference

1. Introduction

Thigh lift is a common procedure in plastic surgery. More than 10,100 thigh lift procedures were done in the United States in 2018 [1].

Thigh lift is a common procedure in plastic surgery. Surgeon's sense or tailor tack is mainly the methods used for designing thigh lift currently. This article is an attempt to find a method/a reference point to define the exact amount of redundancy needed to be excised.

Previously, I had an early attempt to apply the average anthropometric measures in brachioplasty in females. 85:100 is the forearm circumference to mid-arm circumference ratio that I have been using [2]. Thigh has a different structure from arm. In anthropometry, thigh is measured at different circumferences e.g. knee, mid-thigh and upper thigh or gluteal circumferences. Such differences have to be considered.

2. Background

Anthropometry reference measurements can be applied in designing thigh lift surgery. Classically, anthropometry binds lower limb various circumferences with muscle mass, weight and incidence of some diseases e.g. diabetes mellitus, cardiac diseases [3] [4] [5].

Calf circumference can be used as the reference point. Aesthetic thigh is not just about being tight without redundancies, but to look compatible with the calf.

3. Method

Inclusion criteria of studies:

Anthropometric databases and studies done on females addressing different ages, countries and races with average BMI (body mass index) were reviewed. Chosen studies have to include calf circumference, mid-thigh circumference and/or upper thigh (gluteal) circumference measurement methods that follow the next measures:

Calf:

1) The subject stands erect with their weight evenly distributed on both feet and legs slightly apart.

2) The measurement is taken at the level of the largest circumference of the calf. The maximal girth is not always obvious, and the tape may need to be moved up and down to find the point of maximum circumference [6].

Mid-thigh

1) The subject stands erect with the measured limb laterally elevated, on a chair or a table, in 90˚ abduction to avoid mistaken measurements by the redundant skin that will migrate downwards with gravity if the thigh is measured in a vertical position (**Figure 1**).

2) The circumference measure is taken at the level of the mid-point on the lateral (outer side) surface of the thigh, midway between the greater trochanter of the femur and lateral condyle of the tibia [6].

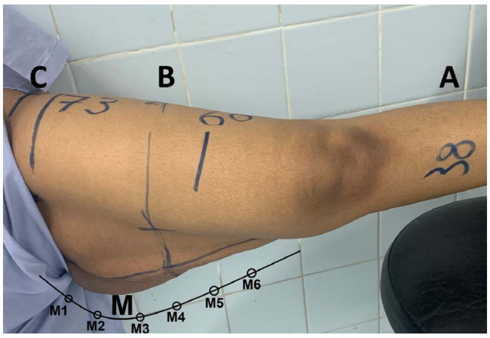

Figure 1. Subject stands erect with the measured limb laterally elevated, on a chair or a table, in 90˚ abduction.

Upper thigh

1) The subject stands erect with the measured limb laterally elevated, on a chair or a table, in 90˚ abduction to avoid mistaken measurements by the redundant skin that will migrate downwards with gravity if the thigh is measured in a vertical position (Figure 1).

2) The circumference measure is taken 1 cm below the gluteal line or fold (buttock crease) [6].

When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and the tape held horizontal [6].

Exclusion criteria of studies

1) Male or mixed gender, statistics

2) Athletes

3) Current morbidities

4) Abnormal BMI groups

5) Different methods of measurement

4. Result

Nine studies were found fulfilling the above criteria. Mean values of calf circumference (A), mid-thigh circumference (B), upper thigh circumference (C) were compared and A:B:C ratio was produced, when possible, in Table 1.

Application

1) Pooled mean was calculated for each variable (A, B, C) to put variation in sample sizes in consideration.

2) Results were as following:

Pooled mean of calf circumference (A) = 36.96 cm

Pooled mean of mid-thigh circumference (B) = 53.06 cm

Pooled mean of upper thigh circumference (C) = 57.69 cm

3) A:B:C = 64.04:91.97:100 ≈ 64:92:100

Design

1) The subject stands erect with the measured limb laterally elevated, on a chair or a table, in 90˚ abduction to avoid mistaken measurements by the redundant skin that will migrate downwards with gravity if the thigh is measured in a vertical position (Figure 1).

Table 1. Nine studies were found fulfilling the above criteria. Mean values of calf circumference (A), mid-thigh circumference (B), upper thigh circumference (C) were compared.

Study	Sample size		A: calf circ (in cm)	B: mid-thigh circ (in cm)	C: Upper thigh Circ (in cm)
MSIS [7] (50th percentile)	26		34.10	-	51.60
Drinkwater DT [8]					
Embaled (*left*)	13		30.43	39.13	48.81
Embaled (*right*)	13		30.74	40.21	49.07
Unembaled (*left*)	13		30.99	43.18	51.43
Unembaled (*right*)	13		29.57	42.73	51.47
Both groups (*left*)	13		30.73	41.31	50.22
Both groups (*right*)	13		30.11	41.57	50.36
ANSUR [9] (Mean calculated)	2208		35.23	-	58.02
ANSUR II [10] (Mean calculated)	1986		37.32	-	61.61
Liu *et al.* [11]	128		35.00	47.00	54.00
Dessalew *et al.* [12]	16		23.30	-	36.90
Churchill *et al.* [13]					
White	1742		33.50	-	54.60
Black	146		34.20	-	55.20
Asian	17		33.30	-	51.50
McDowell *et al.* [14]	A	B			
All races	4133	4065	38.40	52.90	-
Non-Hispanic white	2124	2093	38.40	52.50	-
Non-Hispanic black	612	888	39.60	58.00	-
Mexican American	789	776	37.30	52.00	-
Stirling [15]	153		36.88	-	59.27

2) Measure and record the maximum circumference of the calf (A), mid-thigh circumference (B), upper thigh circumference (C). Mark the three levels circumferentially (**Figure 1**).

3) Calculate the (64:92:100) ratio using the maximum circumference of the calf (A) as a reference value. Results will be taken as reference points to modify the final surgery design.

4) Mark the most medial line of the thigh (M) *i.e.* the lowest line of the redundancy in the 90˚ abduction position. It is supposed to start from the adductor longus tendon by its origin till the medial aspect of the knee (**Figure 1**). Mark several points on the line (M) with around 10 cm in between. Points will be M1, M2, M3, etc. (**Figure 1** & **Figure 2**).

5) Start the surgery in lithotomy position. At each point on the line (M), start the (Stab-Push-Pinch-Mark) or SPPM technique to mark the maximum skin closure limits (**Figure 3**).

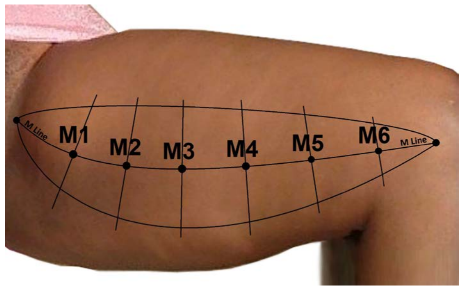

Figure 2. "Anthropometrically referenced Thigh Lift" or (ACTL) final surgical design. I do (Stab-Push-Pinch-Mark) or SPPM technique on each point from M1 to M6 along the M-Line, the most medial line of the thigh, to mark the maximum skin closure limits, then connect the points and draw a surgical design.

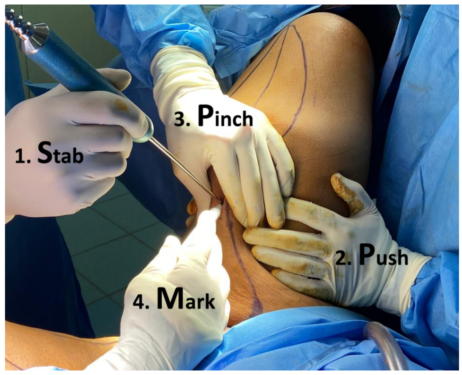

Figure 3. (Stab-Push-Pinch-Mark) or SPPM technique to mark the maximum skin closure limits. Head surgeon (one hand): Push a liposuction cannula or a graded blunt rod perpendicularly against the skin like a stab on one of the (M) points. Assistant 1 (both hands): Push the thigh tissues in a parallel and opposite direction to the cannula. Head surgeon (the other hand): Pinch the skin above and below the cannula to get the maximum capacity of skin closure. Assistant 2 (one hand): Mark the pinched points anterior and posterior to the cannula. Repeat the steps on each M point from M1 to M6.

6) Connect the points and draw a rough surgical design. Slightly, curve the design out distally to be more convex at the distal end to avoid dog ear by the knee side (Figure 2).

7) Compare "Anthropometrically referenced Thigh Lift" or (ACTL) to (Stab-Push-Pinch-Mark) or SPPM technique results. Apply "Anthropometrically referenced Thigh Lift" or (ACTL) results to modify the surgical design, then check symmetry.

8) Within the marked, to-be-excised, area, inject tumescent and start extensive liposuction, leaving thin skin.

9) Peel the skin by diathermy very superficially to spare lymphatics. However, I prefer going slightly deeper by the far distal end of the wound to avoid dog ear formation by the knee side, then close the wound and check symmetry.

10) Push the wound line proximally, with a medium strength, towards the origin of adductor longus. Mark the point where the wound line will meet the beginning of the adductor longus tendon (Figure 4).

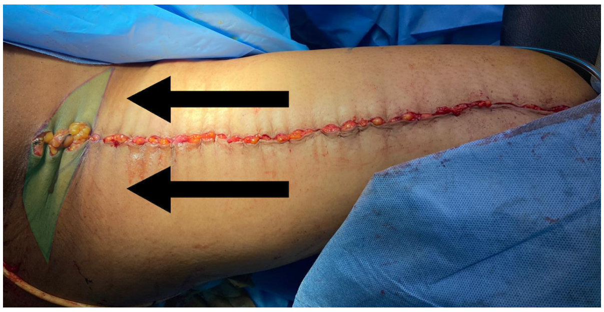

Figure 4. Push the wound line proximally, with a medium strength, towards the origin of adductor longus. Mark the point where the wound line will meet the beginning of the adductor longus tendon. Design a diamond shape (shaded in green) that will be closed to form the new inner crotch line to defy vertical redundancy.

Figure 5. Intraoperative results.

Figure 6. Results 14 days after surgery.

11) Design a diamond shape that will be closed to form the new inner crotch line to defy postoperative vertical redundancy. Anchor the flaps to one stationary point or more e.g. pubic bone, inguinal ligament or adductor longus tendon to distribute the main weight and avoid secondary descent of the scars, and divarication of the labia majora (Figure 4).

5. Conclusion

Postoperative anthropometrically referenced mid and upper thigh circumferences can be calculated by measuring the calf circumference and applying the 64:92:100 ratio. Markings are done intraoperatively using my innovated "Stab-Push-Pinch-Mark" or SPPM technique for drawing a rough surgical design, then tweaked using the anthropometrically referenced 64:92:100 ratio results to make an anthropometrically correct thigh lift (**Figure 5**, **Figure 6**).

Data Availability

The author confirms that the data supporting the findings of this study are available within the article.

Acknowledgements

My gratitude and appreciation to my friend and colleague, Dr. Sherif Elamari for operating together on the example case.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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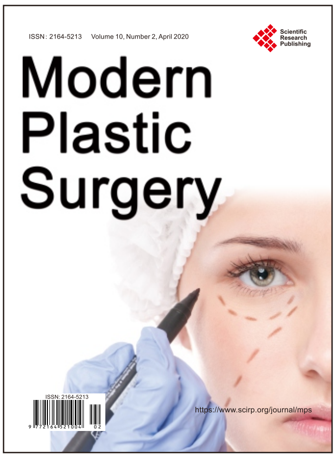

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