



# Abdominoplasty Marking Instrument

## *Instrumento de Marcação de Abdominoplastia*

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### ■ ABSTRACT

**Introduction:** Data from the International Society of Aesthetic Plastic Surgery indicate that abdominoplasty is the fourth most common plastic surgery performed worldwide. Several surgical techniques aim to restore the abdominal contour. The indication for the technique used should aim to improve any individual deformity present in the abdomen. Abdominoplasty marking is done using a ruler, protractor, compass, nylon thread, toothpick, pen, and/or methylene blue, according to the surgeon's preference. Here we aimed to produce a surgical instrument that optimizes the abdominoplasty marking procedure. **Methods:** The study was approved by the ethics research committee. Graphic designs were developed to identify each part of the instrument, a precedence search was performed, and a patent application was requested. **Results:** We developed an abdominoplasty marking instrument consisting of a horizontal ruler that receives a vertical ruler at its midpoint, two pivotal rulers with a basal protractor, all marked in millimeters, and a central area that allows marking in this region with methylene blue or a pen. Moreover, it acts as a compass and features side pivotal rulers derived from a basal grade protractor. **Conclusion:** The instrument developed in this study was designed to minimize the amount of material used and optimize abdominoplasty marking time.

**Keywords:** Abdominoplasty; Reconstructive surgical procedures; Patents as Topic; Abdomen; Innovation.

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## ■ RESUMO

**Introdução:** A abdominoplastia, um dos procedimentos de cirurgia plástica mais comuns no Brasil, ficou em quarto lugar no ranking mundial, segundo dados da *International Society of Aesthetic Plastic Surgery*. Diversas técnicas cirúrgicas visam restaurar o contorno abdominal. A indicação da técnica utilizada deve visar a melhoria da deformidade individual presente no abdome. A marcação da abdominoplastia se faz por meio de régua, transferidor, compasso, fio de náilon, palito, canetas e/ou azul de metileno, de acordo com a preferência do cirurgião. O objetivo é produzir um instrumento cirúrgico com a finalidade de otimizar o tempo de marcação no procedimento de abdominoplastia. **Métodos:** O estudo foi aprovado pelo Comitê de Ética em Pesquisa, foram desenvolvidos desenhos gráficos para identificar cada uma das partes do instrumento, foi realizada a busca de anterioridade e, posteriormente, realizado o pedido de patente. **Resultados:** Foi desenvolvido um instrumento para marcação da abdominoplastia, que configura uma régua horizontal que recepciona uma régua vertical no seu ponto médio e duas réguas pivotantes com transferidor basal, todas essas peças milimetradas e com vazado central, que permitem o risco nessa região com o azul de metileno ou caneta afim e, por conseguinte, a marcação do procedimento de abdominoplastia. Além disso, também funciona como compasso e de cujas laterais derivam réguas pivotantes com transferidor de grau basal. **Conclusão:** O instrumento desse estudo foi criado para minimizar a quantidade de material utilizado e otimizar o tempo da marcação da abdominoplastia.

**Descritores:** Abdominoplastia; Procedimentos cirúrgicos reconstrutivos; Patentes como assunto; Abdome; Inovação.

## INTRODUCTION

Abdominoplasty is one of the most common plastic surgeries performed in Brazil. In 2015, data from the International Society of Aesthetic Plastic Surgery (ISAPS) indicated that abdominoplasty was the fourth most common plastic surgery performed worldwide<sup>1</sup>.

Functional changes, genetics, life habits, inadequate diet, lack of physical exercise, pregnancy, weight loss, aesthetic alterations of the abdominal wall, and other factors contribute to decreasing patient self-esteem and well-being<sup>2,3</sup>.

For more than a century, plastic surgery has sought solutions to correct the abdomen, initially by abdominoplasty and later with liposuction, which are the two cosmetic surgeries most commonly performed in this anatomical area<sup>4</sup>.

The first descriptions of the surgical treatment of abdominal wall deformities were associated with the correction of umbilical hernias, which required the concomitant removal of fat and skin<sup>4,5</sup>.

In 1899, Kelly described a dermofat excision technique, elliptical and transversal at the level of the umbilicus, in which skin and fat were resected together, initiating a challenge for surgeons in the treatment of abdominal deformities<sup>6</sup>.

In 1957, extensive dissection of the dermofat graft was standardized to facilitate transposition of the navel, initiating this important phase in abdominoplasty<sup>7</sup>.

In 1965, Callia positioned the horizontal incision in the suprapubic region, extending it laterally toward the iliac crests and leaving the scar less apparent. This type of incision has had large acceptance and is used today with slight design variations. Pitanguy described rectus abdominis muscle plication at the midline<sup>7,8</sup>.

The introduction of liposuction by Illouz in 1980 enabled the reduction of fat volume of the body contour in patients with excessive adipose tissue without excess or sagging skin. Between liposuction and plastic surgery of the abdomen are intermediate modality interventions called partial abdominoplasties<sup>9</sup>.

Several surgical techniques aim to restore the abdominal contour<sup>10-12</sup>.

Abdominoplasty markings are performed using a ruler, protractor, compass, nylon thread, toothpick, and pen and/or methylene blue, according to the surgeon's preference.

## OBJECTIVE

To develop a surgical instrument that optimizes abdominoplasty marking time.

## METHODS

### Ethical Approval

The study was approved by the Ethics Research Committee (Comitê de Ética em Pesquisa) of the Federal University of São Paulo (Universidade Federal de São Paulo - Unifesp, no. 2355210116).

### Precedence Search

A precedence search was performed in national and international patent databases of the National Institute of Industrial Property (Instituto Nacional da Propriedade Industrial)<sup>13</sup>.

A list of all patents concerning abdominoplasty marking was obtained with a description of each patent and drawing.

### Technological Innovation Nucleus

The invention report, drawings of the instrument, and documents needed to request a filing application for the abdominoplasty marking instrument were forwarded to the village consultancy.

### Description and characteristics

A description of the features and functions of the abdominoplasty marking instrument was created.

### Illustration of use

Graphics were developed to identify each part of the instrument.

## RESULTS

### Description of the instrument components and characteristics

The instrument shown in Figures 1-5 that consists of a horizontal ruler (1), which receives a vertical ruler (2) at its midpoint, and two pivotal rulers (3) with a

basal protractor (4), all marked in millimeters, and a central void (5) that allows marking in this region with methylene blue or pen and, consequently, the marking of the abdominoplasty procedure. It also functions as a compass with laterally derived pivotal rulers (4) with a basal-type protractor (5), all rulers (1, 3, 4) marked in millimeters on both sides and a void in the central axis; a mechanism (9) formed by a screw (10) attached to the blade of the slats (3 and 4) allows movement between the parts.

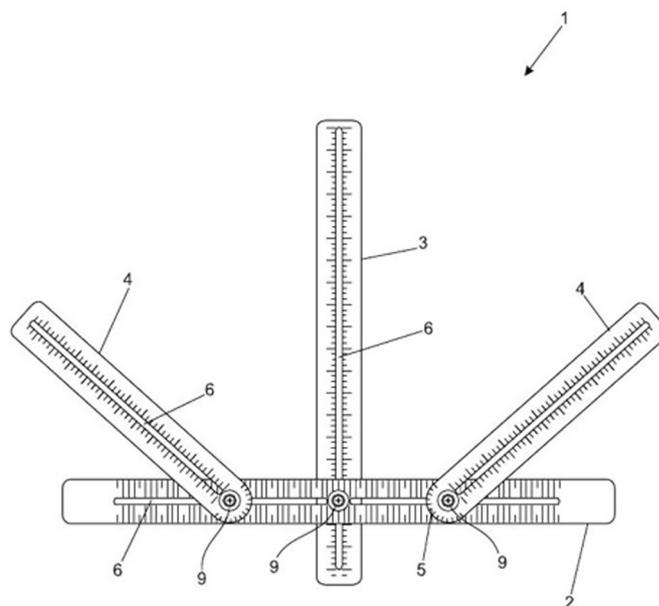
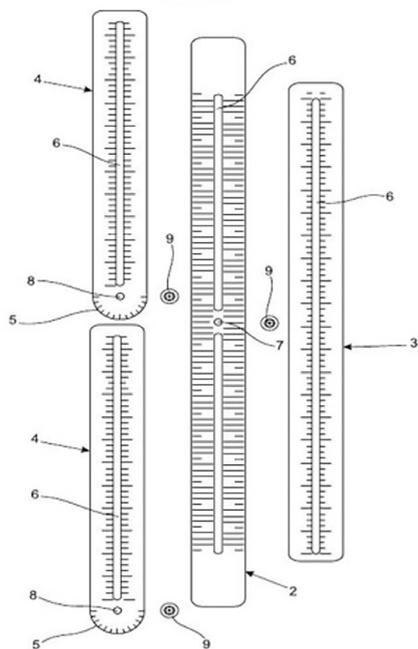


Figure 1. Diagram of the abdominoplasty marking instrument.

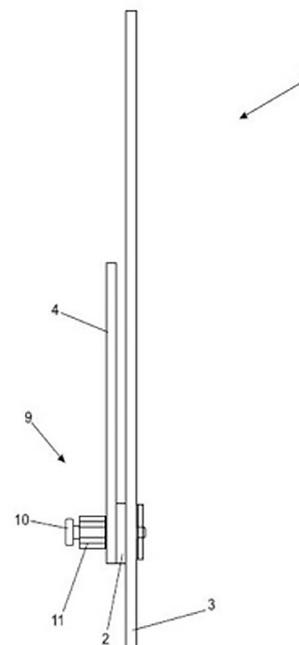
In one example of the invention, the joint between the rulers is achieved using a mechanism (9) formed by a screw (10) fastened to the blade of the slats (3 and 4) in which the tightening and loosening is affected by an acrylic screw (11), but such a grip may be provided by another movable/rotary mechanism.

### Illustration of use

As shown in Figure 5, the methodology of the abdominoplasty marking procedure involves positioning the instrument on the patient's abdomen, where a horizontal line is drawn in the suprapubic region with extensions of approximately 12-14 cm, 7 cm from the vulvar commissure and laterally toward the iliac crests by 6-7 cm on each side. Areas in which liposuction can be performed are also demarcated using this method. The measurements may vary according to the abdominal lipodystrophy of each patient and the marking preferences of each surgeon.



**Figure 2.** Exploded diagram of the abdominoplasty marking instrument.



**Figure 3.** Side view of the abdominoplasty marking instrument.

### Patents found in the precedence search

Chart 1 contains information of three patents found in the precedence search.

#### Description of patent PI 9702889-4

The PLASTIC SURGERY SIMULATOR KIT (Figure 6) provides the resident a practical learning opportunity for various surgical techniques as well as periodic self-assessments. The kit contains breasts (1) or a trunk replica including breasts and an abdomen (2) and is made of suitable materials that simulate skin, glands, and muscles of different colors to indicate the different layers of these regions of the human body and that can constructively limit the “prohibited” areas of access in certain surgical techniques so that, when sensitized (e.g. by the touch of the scalpel), they trigger a visual or audible alarm in addition to counting errors in an electronic panel.

#### Description of patent PI 0106759-1

The surgical marking pen (Figure 7) is used in superficial surgeries to demarcate the area to be operated. It is composed of a rod (1) and a marker tip (2). This tip has an inner orifice (2.1) into which appropriate graphite can be inserted (3), whose main characteristic is to produce an accurate and fixed marking on human skin to perfectly demarcate the area that will undergo incision, or even marker tip; in this case, there is a

cone needle (4) that, when pressed against the skin, will release microquantities of ink, filling the space previously occupied by the graphite and marking the area with the same efficiency.

#### Description of patent PI 9702889-4

The pincers used for navel marking in abdominal surgery (Figure 8) is composed of a scissors body. An extension with a slot in the middle is present on one of its faces with the aim of precisely and definitely locating the navel beneath the skin. On the other side is an extension at which a navel marking device of various forms is positioned on the skin.

#### Public domain instruments used for abdominoplasty marking

The marking of abdominoplasty surgeries is performed according to the lipodystrophy of each patient and the surgeon’s marking preferences.

Chart 2 contains public domain tools used for abdominoplasty marking.

#### Description of the ruler

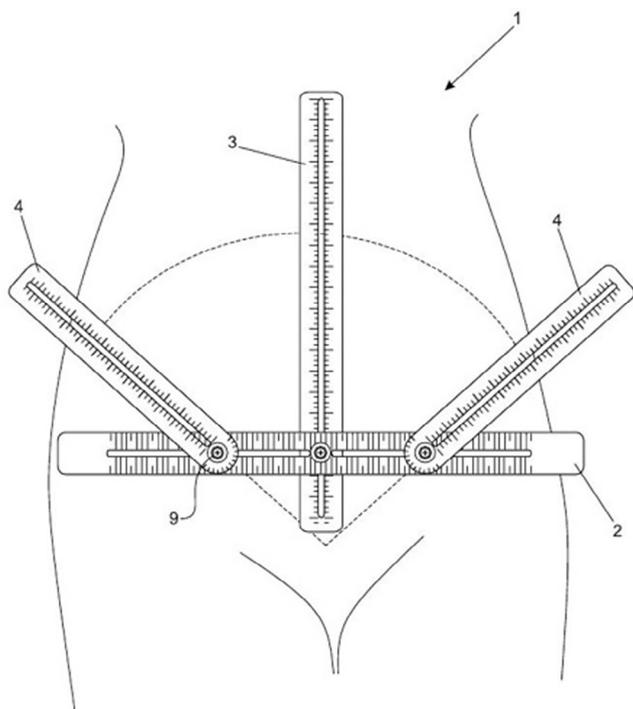
The origin of the word ruler is French and means “law or rule.” Rulers were found in excavations in Mohenjo-Daro in 1500 B.C. This is an instrument used to draw straight lines made in wood, plastic, or metal with measurements marked in millimeters or

**Chart 1.** Precedence search of abdominoplasty marking patents.

Patent	Publication Date	International Classification	Country/ Organization	Inventors
PI 9702889-4	28/03/2000	A61B 17/00	Brazil	Bernardo Sérgio Hochman Resztkowki
PI 0106759-1	14/10/2003	A61B 19/00	Brazil	Anselmo Luiz Penna
PI 9702889-4	01/2006	A618 5/00	China	



**Figure 4.** Enlarged lateral detail of the inter-ruler joint of the abdominoplasty marking instrument. Perspective view of the abdominoplasty marking instrument in transport position.

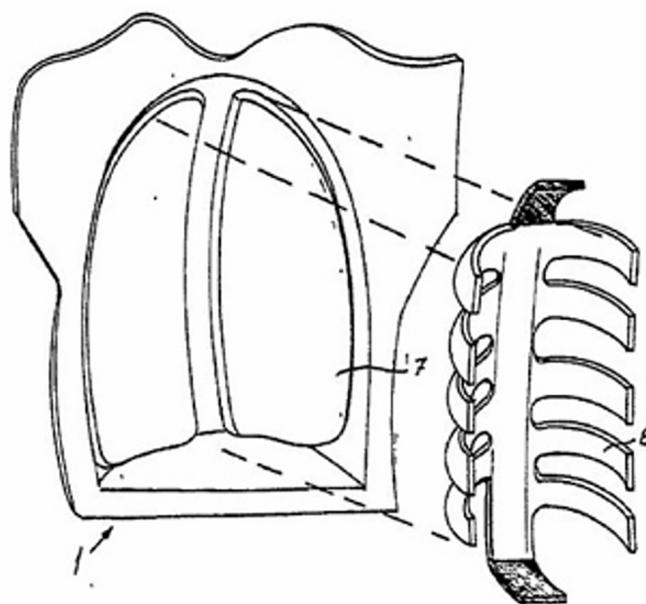


**Figure 5.** Perspective view of the abdominoplasty marking instrument in a demonstration of its use.

centimeters (<http://www.reguaonline.com/sobre-a-regua.html>)<sup>14</sup>.

**Description of the compass**

The compass is a drawing instrument that makes circumferential arcs. It is also used to mark a segment on a line of equal length to that of another given segment and solve some types of geometric problems, such as constructing a hexagon or finding the center of a circle<sup>15</sup>.



**Figure 6.** Plastic surgery simulator kit.

**Description of the protractor**

A protractor is an instrument that is used to measure angles. It is composed of a circular scale, or circle sections, divided and marked at angles spaced regularly as those on a ruler. Its use is diversified in education, mathematics, engineering, surveying, construction, and various other activities that require the precise measurement of angles. There are fixed 360°, 180°, and 90° protractors. Protractors can measure angles not only in degrees but also in thousandths of a degree, such as those used by the military for shooting applications<sup>16</sup>.

**Description of suture wire**

Suturing is a very important step in the surgical procedure. From ancient times, a large number of suturing materials have been tested and used, such as vegetable fibers, resins, tendons, intestines of various

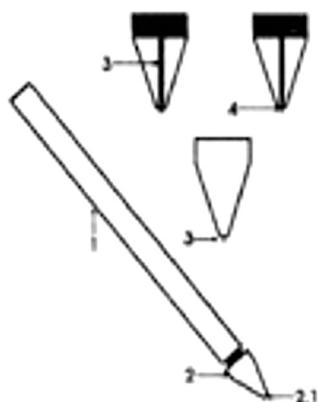


Figure 7. Surgical marking pen.

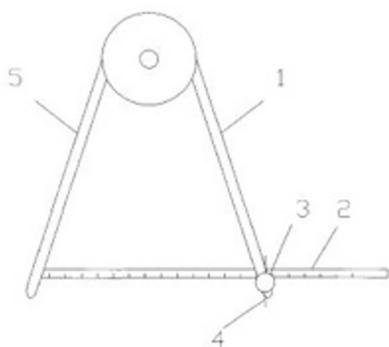


Figure 8. Navel marking pincers.

Chart 2. Public domain tools used for abdominoplasty marking.

Public domain instruments	
Instrument	Purpose
Ruler	Draw straight line segments and measure short distances
Compass	Plot arcs of circumference and mark a segment in a straight line
Protractor	Measure angles
Suture wire	Join tissues and mark straight lines with dyes
Pen	Write, draw, demarcate
Methylene blue	Color
Toothpick	Used as a pen when associated with dyes

animals, horse hair, and gold filaments. One of the earliest mentions of suturing is recorded in Egyptian writing, which dates from 3500 B.C. In the 13<sup>th</sup> century, surgeons began to worry not only about the nature of

the material used for suturing but also about antisepsis. Thus, the trend of using a variety of sterilized suture threads with pre-installed needles that are supplied ready to use began<sup>17</sup>.

**Description of the pen**

The pen is an instrument used for writing with ink. Even today, students use it worldwide for schoolwork. Ballpoint pens, which are mainly used today, were invented in 1937 by the Hungarian Ladislao Biro, based on a pen that did not erase and the ink did not dry in the deposit, unlike old fountain pens.

The pens vary from simple to sophisticated and elegant, such as those commonly used by professionals, and of various colors. Even today they are used worldwide<sup>18</sup>.

**Description of methylene blue**

In 1876, Caro synthesized methylene blue; it has subsequently had various uses in medical research. Methylene blue is an aromatic heterocyclic compound that is solid dark green, soluble in water, and produces an odorless blue solution. Methylene blue dye is used as a bacteriological dye and indicator. It has many applications in various fields, such as biology and chemistry<sup>19</sup>.

**Description of the toothpick**

Toothpicks are small rods usually made of wood or plastic that are frequently used to remove detritus from the teeth, especially after meals, that have existed for hundreds of years. The toothpick usually has one or two sharply tapered ends to ensure better insertion between the teeth<sup>20</sup>.

A chart was prepared with the patent data found in the precedence search with International Patent Classification identification number and code, inventor name(s), date of publication, and place of registration.

Given the patents mentioned previously, comparisons were made with the design of the marking instrument presented in this thesis.

**Comparison between the study instrument and patent PI 9702889-4**

The Plastic Surgery Simulator Kit (Figure 6) is used to train students and residents to perform surgical techniques. The differences between the abdominoplasty marking instrument and patent PI 9702889-4 are described in Chart 3.

**Chart 3.** Comparison between the study instrument and patent PI 9702889-4.

Study Instrument		PI 9702889-4	
Advantage	Disadvantage	Advantage	Disadvantage
Articulated mold for abdominoplasty marking	Does not signal danger zones	Simulators of “organs” to train surgical techniques with flags of danger zones	Restricted to training

### **Comparison of study instrument and patent PI 0106759-1**

The surgical marking pen (Figure 7) is used to delineate markings. The differences between the abdominoplasty marking instrument and patent PI 0106759-1 are described in Chart 4.

**Chart 4.** Comparison of study instrument and patent PI 0106759-1.

Study Instrument		PI 0106759-1	
Advantage	Disadvantage	Advantage	Disadvantage
Articulated mold for abdominoplasty marking	Does not signal danger zones	Allows precise marking of human skin	No demarcation mold

### **Comparison of study instrument and patent PI 0106759-1**

The pincers used for navel marking in abdominal surgeries (Figure 8) is an instrument used in abdominal surgeries; however, its use is limited to marking the navel, unlike the study instrument, which demarcates the entire surgical area with the exception of the navel (Chart 5).

### **Comparison of study instrument and the ruler**

The instrument of study comprises a horizontal ruler that articulates with a vertical ruler at its midpoint and two pivoting rulers. Unlike the public domain ruler, the study ruler features a central empty space that allows marking in this region with methylene blue or a pen to delineate the abdominoplasty procedure. The instrument also has a mechanism formed by a bolt fastened to the blade of the rulers that allows movement between the parts, thus enabling the pivotal slides to also be used as a compass (Chart 6).

After the precedence search, the study of the presented results, and the development of the study

**Chart 5.** Comparison between study instrument and the pincers used for navel marking in abdominal surgeries.

STUDY INSTRUMENT		Patent PI 0106759-1	
Advantages	Disadvantages	Advantages	Disadvantages
Allows abdominoplasty marking	Does not allow navel marking	Allows navel marking only	Use exclusive to the navel

instrument, a patent application as a utility model was made and a deposit was made to the National Institute of Intellectual Property.

## **DISCUSSION**

In 2015, Brazil registered 1,224,300 plastic surgeries, including 758,590 abdominoplasties. A survey of these data has been performed by the ISAPS among the total number of plastic surgeries performed by all plastic surgeons in each of the participating countries<sup>15</sup>.

The search for improvements in body contour and quality of life has led to an increase in demand for plastic surgery<sup>2,21,22</sup>. Professionals should be able to accurately diagnose these deformities and know the alternatives to provide adequate treatment<sup>2,21,23</sup>.

When choosing abdominoplasty, in accordance with the diagnosed deformity, the marking can be made by the surgeon using a ruler, protractor, compass, nylon thread, toothpick, pens, and methylene blue.

Preoperative surgical marking has been reported since the early days of plastic surgery with Sushruta Samhita's description of the use of vegetable leaves to demarcate the nasal flaps and has progressed over centuries to the use of leather and wax and then the more widespread use of incision drawings done with paints and dyes starting in the 19<sup>th</sup> century<sup>8</sup>.

According to the pertinent literature, intraoperative surgical marking has received less attention. Weiss's study (1947) can be highlighted since it advocated the use of technical pens and precision compasses made of aluminum and steel and sterilized in germicidal solutions for use during surgeries.

The use of this study instrument is performed in the following way: the instrument is placed on the abdomen of the patient in the supine position during the pre- or intraoperative period; and it defines the extension of the horizontal trajectory of the suprapubic region, the extension of the vertical trajectory of the vulvar commissure, and the tracing of the extension and the angles of the lateral region toward the iliac crests. Using a pen or methylene blue, the abdominoplasty

**Chart 6.** Comparison of study instrument and the ruler.

Study Instrument		Public Domain Ruler	
Advantages	Disadvantages	Advantages	Disadvantages
Features a central void, a vertical ruler, and two pivots that allow horizontal, vertical, and lateral markings using the same instrument	The size of the vertical ruler does not allow the marking to reach the xiphoid appendix positioned on the pubis	Allows greater reach in the vertical position line that defines the distance between the xiphoid appendix and the pubis	Is able to provide measures of straight lines and angles in a single measure. Different ruler positions (vertical, horizontal, and oblique/lateral bilaterally) and association with the compass are required.

marking is performed in the empty space of the overlapping articulating and millimeter rulers in an easy, practical, and fast manner.

In abdominoplasties performed after major weight loss, the utility of the abdominoplasty marking instrument is reduced to the anchor technique, but the use of its vertical and horizontal components to ensure symmetry and alignment is of great value.

Since the scar's final position results from the traction force of the abdominal flap upward versus the traction suprapubic tissue resistance (pubic region) versus marking precision, this study is important.

**Details of the present invention**

The conventional technique used to mark the abdominoplasty involves the use of a ruler, protractor, compass, nylon thread, toothpick, pens, and methylene blue.

The instrument developed in this study can be used in the pre- and intraoperative periods, has an integrated ruler and compass, is articulated, is easy to handle and transport, and features an empty space in the central region of the rulers to reduce the incidence of misaligned markings and blurring of methylene blue or ink of the chosen pen used for the marking.

**Target audience**

The target audience for abdominoplasty marking instrument use includes plastic surgery trainees and residents and plastic surgeons.

**Applicability and social impact**

- a) Prevention of marking corrections;
- b) Fewer instruments used; and
- c) Facilitation of the surgical teaching of abdominoplasties in accredited medical residency programs.

**Perspectives**

The perspective is that many surgeons and plastic surgery residency services use the instrument developed in this study in their surgeries and teaching practices.

**CONCLUSION**

Here we developed an abdominoplasty marking instrument that minimizes the amount of material used and optimizes the marking time.

**COLLABORATIONS**

- SAAP** Analysis and/or data interpretation, conception and design study, conceptualization, data curation, investigation, methodology, realization of operations and/or trials, resources, writing - original draft preparation, writing - review & editing.
- HCG** Final manuscript approval, project administration, supervision.
- DN** Analysis and/or data interpretation, writing - review & editing.
- EBG** Conceptualization, supervision.
- PRS** Conception and design study, data curation, writing - review & editing.
- PPP** Conception and design study, data curation.
- ORS** Analysis and/or data interpretation, conception and design study.
- LMF** Conceptualization, supervision.

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