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Sub-umbilical Versus Trans-umbilical laparoscopic assisted appendectomy in children: a caregivers-centered cosmetic satisfaction evaluation.

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## ABSTRACT

**BACKGROUND:** Studies suggest that trans-umbilical incisions (TUI) incur better postoperative cosmetic satisfaction scores (CSS) than sub-umbilical incisions (SUI) but a higher incidence of surgical site infection (SSI). We aimed to compare these outcomes after TUI or SUI for uncomplicated pediatric appendicitis (UA).

**METHODS:** Analysis of medical records of 99 children treated at our Institution for UA with TUI or SUI. Caregivers underwent a telephonic interview on post-operative course, filling in the "Patient subscale of the Patient and Observer

**RESULTS:** Of 99 eligible patients, 67 participated to the study (12 SUI and 55 TUI). Groups were similar for age, sex, BMI, histology of the appendix, incidence of granuloma. Compared to SUI group, TUI group presented shorter operative time (min,  $87,5\pm 51,41$  SUI;  $69,43\pm 22,07$  TUI.  $p=0,059$ ), postoperative hospitalization (days,  $3,3\pm 1,1$  vs  $4\pm 1,84$ ), lower rate of SSI ( $2/55$  vs  $2/12$ ) and lower POSAS score ( $11,32\pm 7,65$  vs  $14,25\pm 9,2$ ), even if statistically insignificant. A positive overall opinion in both groups was reported (TUI vs SUI:  $2,13\pm 2$  vs  $2,5\pm 2$ , respectively,  $p=ns$ ).

**CONCLUSIONS:** TUI seems to be preferable over SUI as approach for UA, but larger prospective series are needed to validate these results.

**Key words:** Appendicitis, Children, Cosmetic results, Surgical site infection, Umbilicus.

## **TEXT**

### **Introduction**

Laparoscopic interventions require the creation of a pneumoperitoneum to allow the initial peritoneal access. In order to insert the laparoscope, a trans-umbilical (TUI) or periumbilical incision (PUI) is usually performed. TUI is a vertical incision, located inside the umbilical ring at its deepest depression and cuts through the skin and fascia. PUI is U-shaped, located above (supraumbilical) or below (sub-umbilical, SUI) the umbilicus and cuts through the skin, the subcutaneous fat and the fascia <sup>1</sup>.

Advocated advantages of TUI are the absence of an apparent scar with consequent better cosmetic results, being the incision hidden within the umbilicus <sup>2</sup>. This reflects in a shorter operative time, explained by a lesser number of layers cut during the intervention and by the single full layer suture needed for closure <sup>2</sup>.

Despite its possible advantages, some concerns have been raised toward the potential negative impact of TUI on the rate of surgical site infection (SSI). Since the umbilicus is prone to microbacterial colonization, its avoidance (by performing a PUI instead of a TUI) could reduce SSI <sup>3-7</sup>.

However, all these data are mainly based on adults and, to the best of our knowledge, there are no studies comparing cosmetic satisfaction scores and surgical site infections in children

after TUI or PUI.

Appendicitis is the most common emergency performed in children, with nearly 71,000 appendectomies performed in the United States per year<sup>8,9</sup>. The procedure can be safely performed with a trans-umbilical laparoscopic-assisted approach (TULAA, appendectomy outside the abdominal wall) or with an intra-abdominal laparoscopic approach, both as multi-port and single-port procedure<sup>10</sup>. In terms of clinical efficacy, ease of learning for trainees, operative time and - probably most importantly - low surgical costs, TULAA seems to be preferable over laparoscopic procedure<sup>11</sup>.

The primary objective of this study is to assess the impact of TUI *versus* SUI on the postoperative cosmetic satisfaction score from the caregiver's perspective in children underwent TULAA for uncomplicated appendicitis (UA). Secondary outcomes are to evaluate the rate of SSI and length of operative time (OT) and postoperative hospital stay (LoS).

## Materials and methods

We reviewed the medical records of all the children who underwent TULAA for uncomplicated appendicitis (UA, ICD-9-DC code 540.9) at our Institution from April 2017 to December 2018.

Patient were surgically approached with TUI or SUI according to the surgeon's preference and experience.

### 2.1 Surgical technique

*Trans-umbilical incision (TUI)*: the umbilicus is cleaned thoroughly with cotton swabs, using saline. Routine manual evacuation of debris is performed. After cleaning the umbilicus, skin preparation is done with povidone-iodine. Using two atraumatic graspers to lift the abdominal wall, umbilical skin is everted and incised vertically in the midline extending through the full length of the umbilical ring at its deepest depression to directly reach the fascia. Abdominal wall is enlarged under direct visualization with minimal further dissection to allow the port placement. A 10-mm trocar with pneumatic anchorage is inserted and an 8-10 mmHg pneumoperitoneum is created. Using the all-in-one, side-arm viewing operative laparoscope, a long grasper is used to identify the appendix. Retroperitoneal bands are dissected using the grasper and the tip of the appendix is exteriorized through the umbilicus. An extracorporeal appendectomy is performed by dividing the mesoappendix and the appendiceal base with ties. No endo-mechanical devices are routinely used. Single layer interrupted absorbable suture for abdominal wall closure is performed. Skin is closed using a short-acting absorbable interrupted suture. A small piece of balled-up gauze is placed within the umbilical depression and an adhesive bandage is applied.

*Sub-umbilical incision (SUI)*: after skin preparation with povidone-iodine, a 10-15 mm U-shaped incision is completed following the inferior margin of the umbilical ring. The subcutaneous fat is dissected and the exposed fascia is opened using electrocautery. After opening of the fascia, the trocar is inserted under direct visualization. Then, appendectomy is performed in the same way as for TUI approach. After appendectomy, wound closure is done in a layer-by-layer fashion, with separate closure for the fascia, the subcutaneous fat, and the skin, the latter with short-acting subcuticular suture.

During both approaches, the borders of the surgical incision are left unprotected.

All the patients underwent an ultra-short term pre-operative antibiotic prophylaxis with 1<sup>st</sup> generation cephaloxporine + metronidazole.

Children with perforated appendicitis or converted to open surgery were excluded from the analysis.

For each patient a data sheet was created including demographic data (age at surgery, sex, body mass index), operative time, histological findings, length of hospital stay and post-operative surgical site complications (surgical site infection-SSI, granuloma, dehiscence). For the evaluation of Cosmetic Satisfaction Score (CSS), the parents of all patients were invited to a telephonic interview, filling in the "Patient Scale of the Patient and Observer

Surgical Assessment Scale”, version 2.0 (POSASv2.0) (**figure 1**)<sup>12</sup>.

POSASv2.0 is a validated measurement instrument of scar quality. It consists of two parts: the Patient Scale and the Observer Scale. Both scales contain six items that are scored numerically on a 10-point scale, with 10 indicating the worst response and 1 corresponding to the best response.

The Patient Scale contains six questions applying to pain, itching, color (pigmentation and vascularity), pliability, thickness and relief. Moreover, the patient scores its ‘Overall Opinion’ on scar aspect compared to surrounding normal skin.

A validated translation of POSASv2.0 in our language (Italian) was asked and obtained free-to-use for our non-commercial purpose from the administrator of the POSAS group.

**2.2 Statistical analysis.** T-test for continuous data and Fisher’s test for categorical variables were used for statistical analysis, when appropriate using the Graphpad software (San Diego, California), version 5.0. Data are expressed as mean  $\pm$  standard deviation (SD) and were considered as statistically significant when reaching a  $p < 0.05$ .

## Results

During the 21 months period, 99 patients (66 males, 33 females) were surgically treated for a diagnosis of UA. Among these, we excluded 17 children who underwent conversion to open surgery and 15 children who did not answer to the telephonic interview. The remaining 67 patients (49 males, 18 females) matched all the inclusion criteria for the study. Fifty-five out of 67 (82%) underwent trans-umbilical incision, while 12/67 (18%) underwent sub-umbilical incision. The two groups were uniform in terms of age and sex distribution, BMI and degree of appendiceal inflammation on the surgical specimen (**table 1**). Operative time resulted slightly inferior in the TUI versus the SUI group, even if not reaching a statistic significance (87,5 $\pm$ 51,41 in the SUI group; 69,43 $\pm$ 22,07 min in the TUI group.  $p=0,059$ ). The incidence of granuloma was comparable between TUI and SUI group (2/55, 3,6% versus 0/12, 0%;  $p=1$ ). Surgical site infections were slightly more frequent in the SUI group (2/12, 16,6%) than in the TUI group (2/55, 6%), even if not statistically significant ( $p=0,14$ ). There was a statistical trend in the length of hospital stay, which was longer in the SUI (4  $\pm$  1,8 days) than in the TUI group (3,3  $\pm$  1,1 days;  $p= 0,058$ ).

Analyzing data from the POSAS score (Patient subscale) we found a higher cosmetic satisfaction in the TUI group (mean score, TUI group 11.32 $\pm$ 7.65 vs SUI group 14.25 $\pm$ 9.2) and a positive overall opinion in both groups (TUI group vs SUI group: 2.13 $\pm$ 2 vs 2.5 $\pm$ 2, respectively), without statistically significant difference (**table 1**).

## Discussion

Since the laparoscopy has become the gold standard for most of the procedures in general surgery, the attention of the surgeons has shifted to minimize the scars.

Scarless surgery has become the goal of the minimal invasive surgery<sup>1,9,10</sup>.

From the patient’s perspective, the “body image”, which is the personal perception of our body, can be modified by the presence of a scar<sup>1,5,13</sup>.

This is particularly true for children, because the scar grows with their body, thus augmenting its surface<sup>9,10</sup>.

The umbilicus plays an important role in the cosmetic aspect of the abdomen<sup>14</sup>. As it is often used to gain the access to the abdominal cavity, studies are growing up to find the best

umbilical incision in terms of cosmetic results and less SSI <sup>1,5,6,14</sup>.

The periumbilical incision has been preferred by some Authors over the trans-umbilical incision because it avoids the inner part of the umbilicus, which is thought to contain microbacterial colonization <sup>15</sup>. This hypothesis has been reinforced by studies who confirmed that even a deep antiseptic umbilicus skin preparation fails to eradicate resident bacterias in about 20-25% of cases <sup>4</sup>. Nonetheless, other studies demonstrated that there isn't any association between umbilical microbacterial flora and incidence of SSI <sup>1,5-7</sup>.

In our study (based on a homogeneous population with the same risk of infection) we did not find any difference in the incidence of wound-related complications, such as SSI or granuloma, between the two groups of patients, thus confirming the hypothesis that TUI is a safe incision in terms of risk of infections. In addition, we found a higher percentage of SSI in the SUI group, even if not statistically significant. This could be related to the higher risk of contamination of subcutaneous fat during an unprotected sub-umbilical approach, as we performed. Since the TUI only involves the skin and the fascia, this could explain our slightly higher incidence of SSI in the SUI group.

In addition, several studies state that TUI has shorter operative time, maybe because it only involves the skin and the fascia, thus allowing a single-layer closure of the wound <sup>5,10</sup>. This is consistent with the findings of our study; in fact, it seems that SUI required longer operative time than TUI, but this result did not reach a statistical significance ( $p=0,059$ ).

A few studies exist that compare the cosmetic results between SUI and TUI and none have been performed on a pediatric population. Bouffard-Cloutier et al., in 2017, performed a randomized-controlled trial on adults treated for different conditions (laparoscopic rectopexy, cholecystectomy, appendectomy or proctocolectomy). Patients were randomized into a "trans-umbilical" or "periumbilical" incision group. The Authors' outcome measurements were patients' cosmetic satisfaction, incidence of SSI and operative time. They did not find any significant difference between the two groups <sup>5</sup>.

In our study we obtained the same results: in fact, our patients reached similar positive POSASv2.0 scores and "overall opinion" scores irrespectively of the type of umbilical incision. However, we found slightly higher values of POSAS in the SUI group, thus suggesting better cosmetic evaluation in the TUI group from the caregivers' perspective.

#### **4.1 Limitations of the study**

We are aware of the limitations of our study, mainly related to its retrospective nature. The patients were not randomized and were assigned to a group according to the surgeon's preference.

#### **Conclusions**

To our knowledge, this is the first study that compares cosmetic outcomes after TUI or SUI in children. We can conclude that trans umbilical incision does not increase the risk of SSI nor the operative time even in children and it can be safely performed. From the parents' perspective, trans-umbilical and sub-umbilical access have similar highly valued cosmetic results.

Overall, we found that TUI and SUI can be easily and safely performed in children. Of course, larger randomized-controlled trials are needed to confirm our data.

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## NOTES

*Conflicts of interest.* “The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript”

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*Authors' contributions.*

Maria Enrica Miscia: data collection, statistical analysis and manuscript drafting.

Angela Riccio: data collection and statistical analysis.

Gabriele Lisi: statistical analysis and manuscript drafting.

Mario Fusillo: data collection.

Pierluigi Lelli Chiesa: Manuscript draft correction.

*Congresses.* This study was presented as Poster presentation at the "European Pediatric Surgery Association" (EUPSA) Congress 2019 in Belgrade.

**TABLES**

Table I. Demographic data, post-operative outcomes and cosmetic satisfaction score evaluated with Patient scale of POSASv2.0 of trans-umbilical incision group (TUI) vs. sub-umbilical incision group (SUI). Data are expressed as mean  $\pm$  SD or as proportion.

	<b>TUI (n=55)</b>	<b>SUI (n=12)</b>	<b>p-value</b>
<b>Age (years, mean <math>\pm</math> SD)</b>	10,18 $\pm$ 3,3	10,7 $\pm$ 2,5	0,60°
<b>Sex (M:F)</b>	39:16	10:2	0,49°
<b>BMI (kg/m<sup>2</sup>)</b>	19,3 $\pm$ 4,9	18,5 $\pm$ 2,8	0,60°
<b>Gangrenous appendix (n)</b>	9	2	1*
<b>Operative time (min)</b>	69,43 $\pm$ 22,07	87,5 $\pm$ 51,41	0,059 °
<b>Length of stay (days)</b>	3,3 $\pm$ 1,1	4 $\pm$ 1,8	0,058°
<b>Surgical site infection (n)</b>	2	2	0,14*
<b>Granuloma (n)</b>	2	0	1*
<b>POSAS score</b>	11,32 $\pm$ 7,65	14,25 $\pm$ 9,2	0,25°
<b>Overall opinion</b>	2,13 $\pm$ 2	2,5 $\pm$ 2	0,56°

(° Student's t-test for unpaired data, \* Fisher's exact test)

### **TITLES OF FIGURES**

Figure 1.- The Patient scale of the Patient and Observer Surgical Assessment Scale, version 2.0 (POSASv2.0), investigating 6 items (pain, itching, color, pliability, thickness, relief) and the Overall impression of scar compared to normal skin, on a 1 to 10 points (1= best, 10= worst). (Reprinted with permission from [www.posas.org](http://www.posas.org), copyright © P.P.M. Van Zuijlen, Beverwijk-NL)<sup>12</sup>

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