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A Simple Skin Incision Design for Pediatric Superficial Branch of Superficial Circumflex Iliac Artery

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Background: Superficial circumflex iliac artery (SCIA) perforator flap is one of the demanding flaps. However, little is known about SCIA anatomy, which is crucial for successful SCIA perforator flap elevation, in children. We assessed the efficacy of our incision design to detect the superficial branch of the SCIA in vivo.
Methods: Eleven consecutive pediatric patients who required harvesting (eg, skin grafts or vascularized lymph node transfer) were assessed. All possible congenital vascular malformation cases were excluded. To reduce potential bias, all groin procedures were performed on the contralateral side of malformations. After inguinal area mapping, 1.5-cm skin incision was made. From the window opened by the skin incision, tiny perforation to the skin surface was detected for further dissection. Following the tiny branch, the main trunk of the superficial circumflex vascular bundle was dissected. The whole vascular bundle, artery, and major vein from the bundle were dissected and their sizes were measured.
Results: Of the 11 patients, 4 were boys; the age range was 5 months to 14 years (mean age: 3.2 years). Vessel bundle size was 0.7–1.5 (mean: 1.1 mm). In all cases, the bundle was detected within 5 min (1–5, mean: 2.5 min). No vascular damage was observed, and all arteries pulsated well, without requiring additional skin incision. The superficial branch of the SCIA was mainly detected right below the initial skin incision.
Conclusions: Our skin incision design can effectively detect the SCIA in pediatric patients and may be used in adult patients. *(Plast Reconstr Surg Glob Open 2019;7:e2159; doi: 10.1097/GOX.0000000000002159; Published online 2 April 2019.)*

INTRODUCTION

The development of perforator flaps has popularized minimally invasive free flap reconstructions not only for adult patients but also for pediatric patients. The superficial circumflex iliac artery (SCIA) perforator (SCIP) flap is one of the most demanding flaps because it enables the inclusion of multiple components with 1 source vessel, and the donor site scar can be concealed by underwear. Furthermore, flap elevation with the superficial branch of the SCIA (SB-SCIA) as the source vessel has many advantages such as shortened surgical time and decreased donor morbidity owing to no damage to the deep layered tissue.

SCIP flap elevation can be performed using 2 major procedures: from distal to proximal or the opposite.[1,2] Individual differences have been reported in the dominant vasculature in the groin area[2]; for successful flap elevation, it is important to detect the blood stream preoperatively with ultrasound or Doppler and access the vascular bundle with a proximal approach. However, infants and some pediatric patients were intolerant to this preoperative approach because they could not stay still. Therefore, anatomical assessment of the SB-SCIA is helpful for successful SCIP flap elevation in pediatric patients. To the best of our knowledge, anatomical assessment of the SB-SCIA in pediatric patients has not been performed previously. Moreover, the cadaver study of pediatric patients is not common. Therefore, we developed the skin incision design for the stat detection of the SB-SCIA in cases of SB-

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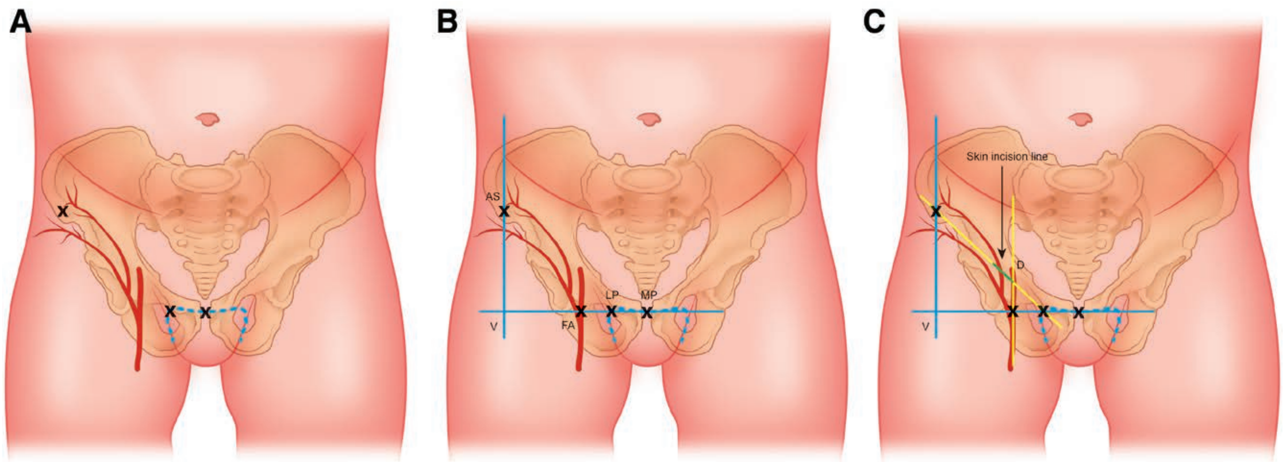


Fig. 1. How to draw the skin incision. A, Three points were determined as landmarks. B, Line MP-LP and vertebral line from AS to MP-LP line. The intersection was named as D. The pulsated center of the femoral artery on the MP-LP line was marked as FA. C, The line AS-LP and vertebral line from FA were marked. The designed skin incision was 1.5 cm from the intersection of the lines to AS.

SCIP flap transfer. We aimed to evaluate the efficacy of our system for detecting the SB-SCIA location and measuring the vessel diameter.

MATERIALS AND METHODS

Patients

Our study included 11 consecutive pediatric patients who required harvesting, either skin grafting or vascularized lymph node transfer, from the inguinal area. All procedures were performed under general anesthesia in the supine position by 3 certificated plastic surgeons, randomly. No incision was made in the bilateral groin area. The study protocol was approved by our institutional ethical board. Informed consent, as a part of the operation consent form, was obtained from the guardians of the patients.

Skin Incision Design

The incision design was applied on the contralateral side of the malformation to reduce the possible bias due to vessel anomaly. All patients were placed in the supine position. The skin incision was performed in 3 steps (Fig. 1).

First, we marked the following points: the anterior supine of the iliac bone (AS), lateral superior edge of the pubis (LP), and the superior medial edge of the pubis (MP; Fig. 1A). Second, we marked a line between these pubis points (MP-LP), a vertebral line on the AS perpendicular to the pubis line (V-AS), and the pulsated center of the femoral artery on the pubis line (FA; Fig. 1B). Third, we drew a line joining AS and LP (AS-LP), and the intersection with the parallel line to V-AS (drawn from FA) was named as D. The skin incision was designed 1.5 cm toward AS on AS-LP (Fig. 1C), and the SB-SCIA bundles were dissected under 2.5× surgical loupe magnification. The distances MP-LP, LP-FA, FA-V, and V-AS were measured for the analysis. The size of each distance, the dissection time, calibers of the bundle and each vessel, and the point at which the surgeon detected the bundles were evaluated. In cases of skin graft harvesting, just after the SB-SCIA was measured, the dissection was completed to reduce unnecessary damage to the deep layered tissue. Before vessel measurement, 2% lidocaine was applied from the surface of the vessels to release possible vascular spasms. The tissue harvest was not performed until the vascular investigation was complete.

Statistical Analysis

The statistical analysis was performed using the Student's *t* test.

RESULTS

Of the 11 patients, 4 (37%) were boys. The age range was 5 months to 14 years (mean: 3.2 years, median: 1.0 years). Eight of 11 (79%) cases were either of burn injury or congenital syndactyly who required skin grafts. No patient had congenital anomaly on the inguinal area.

In all patients, the SB-SCIA bundle was successfully dissected within 5 min (1–5 min, mean: 2.5 min) (Fig. 2). No vascular damage was observed. All dissected arteries pulsated well, without requiring additional skin incision [**see video, Supplementary Digital Content 1**, which displays dissection of the SB-SCIA vascular bundle with a skin incision made using the present stat design system (case #9), http://links.lww.com/PRSGO/B19]. The vessel bundles were 0.7–1.5 (mean: 1.1 mm), arteries were 0.5–0.7 mm (mean: 0.58 mm), and the dominant concomitant vein was 0.4–0.8 mm (mean: 0.52 mm) (Table 1). The SB-SCIA bundle was mainly detected right below the initial skin incision line. Only in 3 cases (27%), the bundle was detected slightly medial or lateral to the initial incision, however, within the skin traction distance. No postoperative complications were detected at the donor site.

The lengths between LP-FA and FA-V were 20–33 mm (mean: 23.6 mm) and 20–33 mm (mean: 24.2 mm), respectively. The LP-FA/FA-V ratio was 0.98 ± 0.04 (Table 1).

DISCUSSION

We developed a simple incision design to detect the SB-SCIA for SCIP flap elevation in pediatric patients.

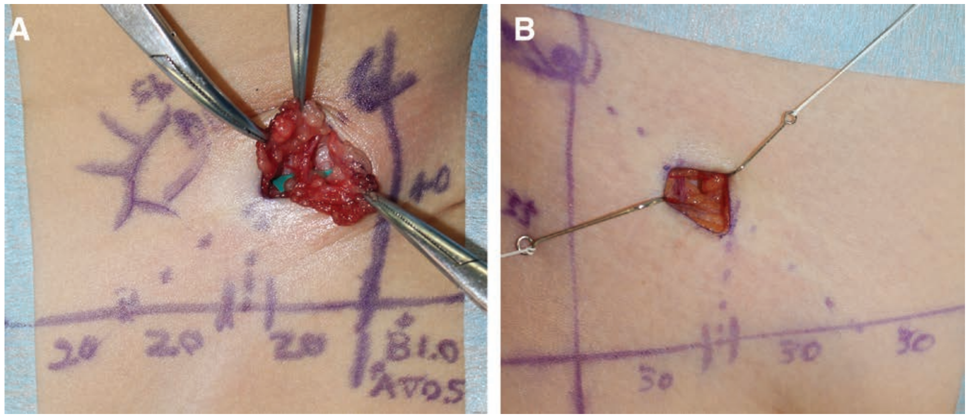
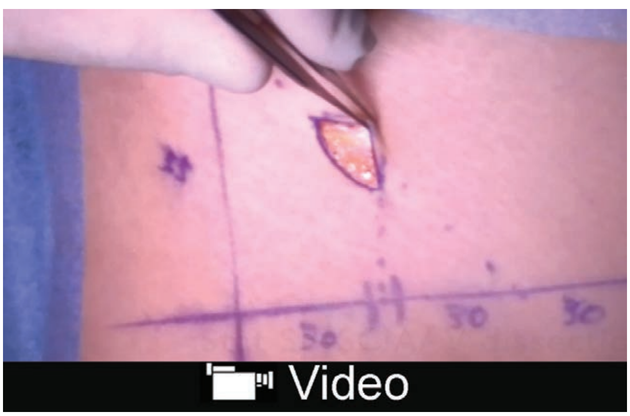


Fig. 2. Clinical cases, the SB-SCIA/V vessels were detected under small skin incision. A, Clinical design and the detected SB-SCIA vascular bundle (case #2). B, Clinical design and the dissected SB-SCIA vascular bundle (case #9).



Video Graphic 1. See video, Supplemental Digital Content 1, which displays dissection of the SB-SCIA vascular bundle with a skin incision made using the present stat design system (case #9). This video is available in the "Related Videos" section of the Full-Text article at PRSGlobalOpen.com or available at http://links.lww.com/PRSGO/B19.

In all the present cases, detection was easily possible within 5 min.

The SCIP flap is a modified perforator flap of the conventional groin flap.[3,4] Groin flap was the first vascularized skin-free flap reported in the early 1970s.[5] The perforator-based flap on the groin area was established in 2004.[4] Recent studies have performed flap elevation above the superficial layer by only including the SB-SCIA to reduce donor morbidity.[1,6] Although this flap elevation procedure was less invasive, the vascular diameters were sometimes very small, occasionally requiring supermicrosurgical anastomoses.[6–8]

The SCIP flap vascularized based on the superficial branch (SB-SCIP flap) has the following advantages: decreased donor morbidity,[9–11] reliable vascularity,[4,12] short time for flap elevation,[1,8,13] and multiple tissue/component inclusion.[13–17]

These advantages are particularly meaningful in pediatric patients.[10,18–23] The donor site has been frequently used for skin graft harvesting.[18,19,23] The donor site scars are usually concealable with underwear.[20, 22] Furthermore, the SB-SCIP flap elevation does not include deep tissue dissection, including lymphatic system or nerves, thereby preventing possible postoperative complications such as lymphorrhea or nerve injury.[8,12,24] The flap can be elevated with an axial pattern vascularity, reducing vessel damage.[8,15] In the present study, all cases had well-pulsated arteries with 0.5-mm diameter. Supermicrosurgical anastomoses are typically required for free tissue transfers; no-

Table 1. Patient Characteristics

No.	Sex	Age (y)	Age (m)	Dissected Side	Diagnosis	Complication	MP-LP (mm)	LP-FA (mm)	FA-V (mm)	V-AS (mm)	SB Artery (mm)	SB Vein (mm)
1	M	0	5	R	Syndactyly hand		21	21	21	20	0.5	0.5
2	F	0	11	L	Syndactyly foot		20	20	20	40	0.5	0.5
3	F	0	11	L	Syndactyly foot		20	20	22	30	0.5	0.4
4	M	0	11	L	Syndactyly foot		20	20	20	40	0.5	0.5
5	M	0	11	R	Syndactyly hand		20	20	20	30	0.7	0.5
6	F	1	0	L	Nevus		20	20	21	40	0.6	0.5
7	M	1	5	R	Nevus	Extremely low body weight infant (300 g)	20	20	20	15	0.5	0.4
8	F	3	0	R	Burn contracture		25	25	28	40	0.6	0.5
9	F	7	3	R	Lymphedema		30	30	30	55	0.7	0.8
10	F	12	0	R	Burn contracture		30	31	31	62	0.8	0.7
11	F	14	3	L	Syndactyly hand		32	33	33	64	0.5	0.4

The distances LP-FA and FA-V were almost the same in every patient. V-AS increased with increasing patient age, except in 1 patient who was born with extremely low body weight (patient #7).

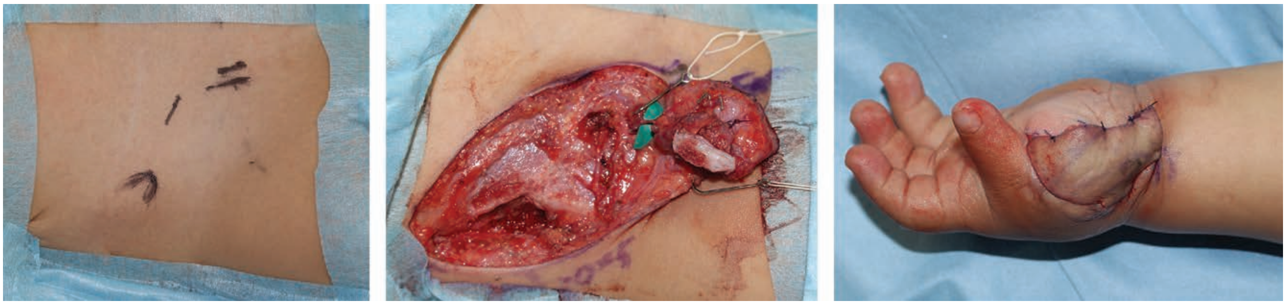


Fig. 3. A clinical application of the present design to transfer SCIP flap with vascularized iliac bone for a one year-old boy with congenital hypoplastic thumb.

tably, elevation and anastomosis are possible because the vessels are larger than 0.5 mm in diameter, as seen even in the infants of the present study. Importantly, we can reduce surgical time for SCIP flap elevation by proximal dissection of the SCIA. Furthermore, multiple tissues such as lymph nodes, lymph vessels,[8] bones,[25] muscles,[26] adipose tissue, and skin can be included with a single source vessel. In addition, the flap can be trimmed to meet the demands of the defects, such as pure skin perforator flap for very thin skin flap or multiple skin paddles.[1,8]

The proximal dissection for initial source vessel detection has been advantageous because the surgeons can be aware of the vascular system included into the flap.[2] The relationship among other branches for the groin flaps was considered complementary; sometimes, the vascularity was reliable on either the deep branch of the SCIA or superficial inferior epigastric artery system. Our skin incision was made in the middle of the positions of these other possible flaps; therefore, switching to those flaps is possible using the initial incision in the case of complications such as pedicle damage during the dissection.

This design is based on the relative position according to body points, and not on the absolute distance, and therefore, can be applied across all age groups. Furthermore, the distances LP-FA and FA-V were almost equal in all patients (LP-FA/FA-V ratio: 0.98 ± 0.04). Therefore, a simple skin incision line from the middle point of AS-LP toward AS might also be a substitute. In fact, we were able to elevate and transfer the SCIP flap with vascularized iliac bone included in a 1-year-old boy with hypoplastic thumb (type 3) (Fig 3).

Previous perforator location analysis studies on adult patients were mainly designed based on the distance from the AS-LP, the inguinal ligament. Few studies have reported the perforator location of pediatric SCIA. However, our study results reveal that the vertebral length (V-AS) increases more drastically than the horizontal length (MP-V) with body growth, and the inguinal ligament angle changes with increase in body size. Therefore, our incision design might be better suited to pediatric settings because the landmark points are constant, and the inguinal ligament angle was not factored in our system.

Our study has limitations. We might have overtaken the other branch as the SB-SCIA because we did not dissect the entire vascular length to avoid unnecessary damage to the pediatric patients. However, preoperative ultrasound showed the branch to be SB-SCIA. Furthermore, for flap elevation from the groin area, identifying the dominant and reliable vessel is a major concern, which was successfully achieved with our design. Moreover, based on our clinical experience of SCIP flap elevation, the location of the SB-SCIA was compatible with that found using the present design. Further studies with larger number of cases should be conducted to validate the results presented here and develop effective variations.

CONCLUSIONS

Altogether, this study is the first to conduct an SCIA anatomical study in pediatric patients. The skin incision design developed here effectively detected the SCIA in pediatric patients and may also be applied to adult patients.

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