Neurovascular Anatomy of the Deep Inferior Epigastric Perforator Flap for Breast Reconstruction

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Objective: *To find out the most suitable perforator and cutaneous nerve for strategic design of the deep inferior epigastric perforator (DIEP) flap.*
Material and Method: *The characteristics of the pedicles, perforators, intercostal nerves and the relationship between nerves and vessels in DIEP flaps were studied in 31 formalin-preserved cadavers.*
Results: *Four hundred and five perforator vessels were divided into three vertical rows. These perforators were mostly contained in the medial row (45.4%), the average size of the perforators in the lateral row was the largest (1.0 $\pm$ 0.3 mm). The largest perforators (1.4 $\pm$ 0.3 mm) were mostly located within 1 cm horizontally from the umbilicus. Lateral row perforators, usually rectilinear course (82.7%), traveled with nerves from the beginning. Whereas, the perforators in the medial row usually coursed obliquely (86.4%) and were not related to nerves initially, they joined before piercing the rectus sheath.*
Conclusion: *The present findings indicate that it would be more beneficial to use the lateral row perforators.*

Keywords: *Deep inferior epigastric perforator (DIEP) flap, Breast reconstruction*

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Autologous breast reconstruction has been established as a reliable and reproducible technique following mastectomy[1-3]. Among technical options, transverse rectus abdominis myocutaneous (TRAM) flap has the advantages of versatility and thorough study of its anatomy. Despite the cosmetic benefits such as resultant scar and appearance of the donor site, some questions have been raised concerning the rectus abdominis muscle resection[4-10].The known complication are muscle weakness and abdominal hernia[10-12]. In 1994, Allen and Treece introduced the concept of perforator flaps. The development of the deep inferior epigastric perforator (DIEP) flap have brought new modifications to the conventional abdominal flaps[3,13] due to maintenance of well-vascularized tissue and total muscular preservation. Thus, the DIEP flap could reduce the likelihood of abdominal bulging or muscular weakness[14]. In addition, dissecting the pedicle of the DIEP flap through the rectus abdominis a considerable increase in pedicle length can be achieved, which allows greater freedom of design[7,10,15-17]. This procedure also has an improvement of the abdominal contour because the abdominal wall is closed as in an abdominoplasty[7,18]. Despite these advantages, reconstruction with the DIEP flap is not a reproducible procedure, and its main limitation is its operative complexity and longer learning curve. The perforating vessels are small, and easily damaged, besides requiring detailed anatomical knowledge[3,7]. At first, the flap was thought to be devoid of sensation, but recent studies have reported the spontaneous return of sensation in 60%-80% of reconstructed breasts[19-22]. Spontaneous recovery of sensation is, however, inconsistent and unpredictable. Recent attempts have been made to improve the quality and

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consistency of sensory recovery in flap by coapting segmental nerve from abdomen to cutaneous branch of intercostals nerve[13,23-26].

Although, it is not difficult to find deep inferior epigastric perforators, the authors supposed to suggest a location of the best perforator and nerve for strategic design of DIEP flap to reduce the operative time and the risk of vascular and nerve injury.

Material and Method

A study was carried out on both sides of 31 formalin-preserved adult human cadavers at the Department of Anatomy, Faculty of Medicine, Chulalongkorn University. The dissection commenced from the lateral to medial direction. The skin and subcutaneous tissues were dissected together from the rectus sheath. The perforator vessels were identified at their points of piercing the rectus sheath. The rectus sheath was opened around the course of the perforators and then excised using fine scissors to facilitate the dissection. Then, the rectus muscle fibers were gently split vertically around each perforator branches. To study the course of the deep inferior epigastric perforators, the perforator vessels were followed meticulously between the muscle fibers toward their origin from the divisions of the deep inferior epigastric artery. Then the fascia was opened vertically between the external abdominal oblique muscle and the lateral border of the rectus abdominis muscle. The linear alba at the midline was excised and then the rectus muscle was lifted up to study the course of the deep inferior epigastric artery. Nerves were identified and followed as they penetrated the anterior rectus sheath, transversed the rectus abdominis muscle and terminated as cutaneous branches. The relationship of these nerves to the vascular perforators and the deep inferior epigastric pedicle were observed. The external diameter and length of the pedicle were recorded, at the distance from its entry into the lateral border of the rectus abdominis muscle to the furthest perforator. All of the perforators were measured the external diameter, at their points of piercing the rectus sheath, by vernia caliper. The locations were recorded, that umbilicus and midline were landmarks.

Statistical analysis was undertaken with SPSS version 11.5. The data of measurements were analyzed by descriptive statistics as means, standard deviations, ranges, and percentages. Difference between parameters was compared by one-way ANOVA and independent t-test as appropriate. A p-value < 0.05 was considered significant.

Results

1. The deep inferior epigastric pedicle

1.1 The pattern of the pedicle

The origin of the deep inferior epigastric artery was a single branch from the external iliac artery. The pedicle approached the rectus abdominis from its lateral aspect approximately 2.0 ± 1.0 cm below the anterior superior iliac spine (ASIS) (range from 1.1 cm rostral to ASIS to 4.2 cm caudal to ASIS). It passed superiorly on the deep aspect, and parallel to the muscle fibers. Then it entered the muscle substance generating a variable number of perforator vessels. After it entered the muscle, it was found to consist of a single main stem in 42 flaps (69.4%) (Fig. 1A). In 19 flaps (30.7%) were double main stems being medial and lateral divisions. The lateral divisions running roughly lateral to the middle of the muscle and the medial divisions that situated medially to the median line of the muscle (Fig. 1B).

1.2 The length and diameter of the pedicle

The lateral division was the dominant branch (larger diameter and longer length) in the majority of cases (15 cases, 79%), whereas the medial branch was dominant in only four cases (21.1%). The average length and external diameter of the lateral branch, medial branch, double stems and single stem are shown as Table 1. The pedicle external diameter was an average of 3.1 ± 0.5 mm. The average pedicle length was 12.1 ± 2.2 mm. The average external diameter of the single pedicle and double pedicles at the lateral border of the rectus abdominis were 3.2 ± 0.4 mm and 2.9 ± 0.5 mm, respectively. The average length of the single pedicle and double pedicles were 12.8 ± 2.2 mm and 11.7 ± 2.2 mm, respectively. There was no statistically significant difference in length or diameter of the medial branch and the lateral branch ($p > 0.05$). Whereas, there were significant differences between the dia-meters of the single stem and double stems ($p < 0.05$). However, there were no significant differences between length of single stem and double stems ($p > 0.05$).

2. The perforators

2.1 Number, location and external diameter of perforators

Four hundred and five perforator vessels were dissected from 62 DIEP flaps (6.5 vessels per flap). Three vertical rows of perforator vessels were observed along the anterior rectus abdominis sheath, first in the lateral third, second in the middle third and other

in the medial third of the muscle. The medial row contained the greatest number of the perforators (45.4%) (Table 2).

The positions of perforators emerging from the anterior rectus sheath were in the area ranging from 3.8 cm superior to the umbilicus to 11.5 cm inferior to the umbilicus. The average distance superior to the umbilicus were 1.8 $\pm$ 1.1 cm and 3.9 $\pm$ 2.5 cm inferior to the umbilicus. These perforators were concentrated within 3 cm below and 7 cm horizontally from the umbilicus (Fig. 2). The average external diameter of perforator was 1.0 $\pm$ 0.3 mm. The average external diameter of lateral row perforator was the largest diameter (1.0 $\pm$ 0.3 mm). But there were no significant differences among diameters of the lateral, the medial, and the intermediate perforators ($p > 0.05$).

2.2 The largest perforators

The largest perforator in each flap had the external diameter ranging from 0.9 to 2.0 mm with an average of 1.4 $\pm$ 0.3 mm. The largest perforators were usually located at the umbilicus level. The perforators were most frequently found in the medial row (60%) whereas 25% was in the lateral row, and the least 15% was in intermediate row (Fig. 3.1). The location of the perforator most frequently found was within 1 cm horizontally from the umbilicus (Fig. 3.2).

2.3 The intramuscular course and distribution of the perforators

Regarding the course of the intramuscular perforator vessels, two different paths were observed. A rectilinear perforator vessel course was observed in the intermuscular septum reaching the subcutaneous tissue. In this pathway, the distance from the flap to the deep inferior epigastric vessels was shorter and ran more perpendicularly through the muscle fibers. During flap harvesting, the muscle was split in a longitudinal direction without muscle resection. An oblique perforator vessel ran in more than one intermuscular septum to reach the subcutaneous tissue. The distance from the flap to the main pedicle was longer, and sometimes some muscle resection was needed to free the perforator vessels. The dissection was more tedious, requiring extensive longitudinal splitting of the rectus muscle.

Concerning location of the perforator vessels and intramuscular course, three distinct patterns were observed. On the lateral row, 82.7 percent of the perforator vessels presented the rectilinear course. However, on the medial row, only 13.6 percent presented this anatomical path and on the intermediate row 50 percent presented the rectilinear course (Table2).

3. The relationship of the nerve to the vascular perforators

The authors observed variations of the distribution of the segmental nerves within the flap. There were 3-6 intercostal nerves throughout each flap with an average of 4.1 nerves per flap. For all 62 flaps, there were three nerves per flap on 14 cases (27.8%), the most variation was four nerves per flap on 29 cases (46.8%), five nerves per flap on 15 cases (24.2%), and only four cases (6.5%) were six nerves.

Intercostal nerves passed between the internal abdominal oblique and the transverses abdominis. The nerves pierced the lateral angle of the rectus sheath, and ran posteroinferiorly to the rectus muscle for 1-6 cm before entering the muscle. The nerves usually ran obliquely and anteriorly to the deep inferior epigastric vessels and split into the sensory and the motor branches. The motor branches radiated their fiber in all directions within the muscular plane to innervate the muscle. The sensory branches joined with the lateral, the intermediate, and the medial vascular perforators of the deep inferior epigastric pedicle. The sensory branches that joined with the lateral and the medial perforators were the most frequent type (Table 3). While some of the cutaneous branches did not travel with the perforator but pierced the rectus sheath to innervate the skin alone. The lateral row perforators, which usually were rectilinear course, traveled with nerves from the beginning. Whereas the medial row perforators, usually with oblique course, were not initially related to nerves. However, they accompanied each other before piercing the anterior rectus sheath (Fig. 4B).

Discussion

Tissue transplantation by free flaps is the method of choice for breast reconstruction, combining the quantity and quality of autologous tissue with the mobility of free flaps to mimic the contralateral breast tissue in shape and volume. Further modifications in harvesting free flap basing on detailed anatomical studies and the relevance of donor-site morbidity, became a key element in selecting procedures and tissues for reconstruction. This is the reason for the great interest in perforator flaps, for their functional deficit is avoided by harvesting just adipocutaneous tissue rooted on musculocutaneous perforators leaving the muscles and motor nerves intact. Many of the

Table 1. The length and external diameter of the pedicle, mean ± SD (range)

	N	Length (cm)	Diameter (mm)
Medial branch of double stems	19	7.6±2.7* (2.5-12.4)	2.1±0.4** (1.3-2.8)
Lateral branch of double stems	19	9.3±2.6* (5.0-15.0)	2.3±0.4** (1.6-3.2)
Double stem	19	12.8±2.2*** (8.8-17.5)	2.9±0.5**** (2.1-3.7)
Single stem	43	11.7±2.2*** (7.2-16.0)	3.2±0.4**** (1.3-4.2)

* distance from the origin of the bifurcation to the most distant perforator
** at its bifurcation
*** distance from its entry into the lateral border of rectus abdominis muscle to the most distant perforator
**** at lateral border of rectus abdominis

Table 2. The number, location, external diameter and intramuscular course of perforator vessels (n = 405)

	Number	Average diameter (mm)	Oblique course	Rectilinear course
Medial row	184 (45.4%)	0.96±0.32	159 (86.4%)	25 (13.6%)
Intermediate row	94 (23.2%)	0.96±0.27	47 (50.0%)	47 (50.0%)
Lateral row	127 (31.4%)	1.01±0.26	22 (17.3%)	105 (82.7%)
Total	405 (100%)	0.97±0.29	228 (56.3%)	177 (43.7%)

Table 3. The patterns of intercostal nerves related to the perforators in DIEP flap (n = 258)

Patterns of intercostal nerve	Frequency
Accompanying with only medial perforator	37 (14.3%)
Accompanying with only intermediate perforator	24 (9.3%)
Accompanying with only lateral perforator	19 (7.4%)
Accompanying with both medial and intermediate perforators	25 (9.7%)
Accompanying with both medial and lateral perforators	50 (19.4%)
Accompanying with both intermediate and lateral perforators	16 (6.2%)
Accompanying with medial, intermediate and lateral perforators	13 (5.0%)
Cutaneous branch not accompanying with perforator but piercing alone	37 (14.3%)
Cutaneous branch piercing alone and accompanying with medial, intermediate or lateral perforators	20 (7.8%)
Non cutaneous branch	17 (6.6%)

Table 4. The pattern of the pedicle

Year	Author	Cadavers	Pattern of pedicle
1960	Frank J Milloy[19]	115	Single branch (86%)
1984	Brian Boyd et al[28]	25	Double branch -
1993	Itoh and Arai[9]	17	Double branch (82.4%)
2005	Offman SL et al[30]	5	Double branch -
2005	Present study	31	Single branch (69.3%)

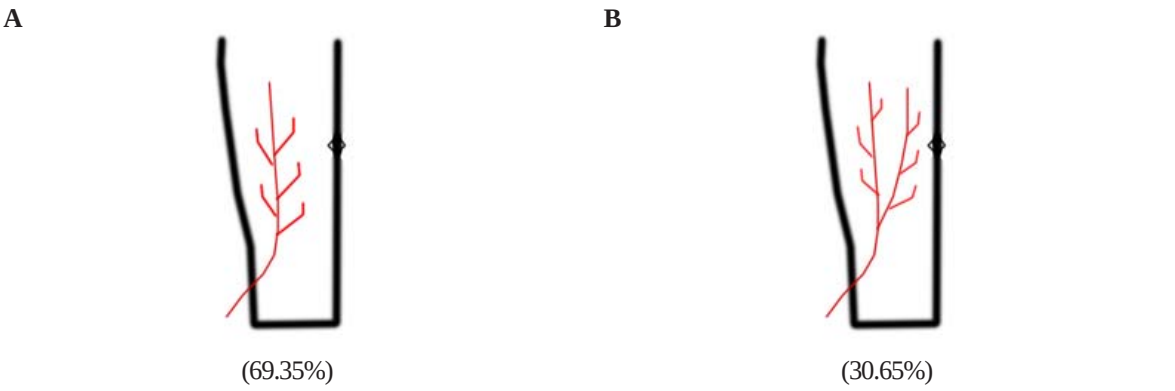

Fig. 1 (A) Example of single main stem of the deep inferior epigastric artery. The pedicle approaches the rectus abdominis from its lateral aspect and courses parallel to the muscle fiber before entering the muscle substance and giving of a variable number of the perforator vessels. (B) Example of the double main stems. The artery divides into the medial and the lateral branches

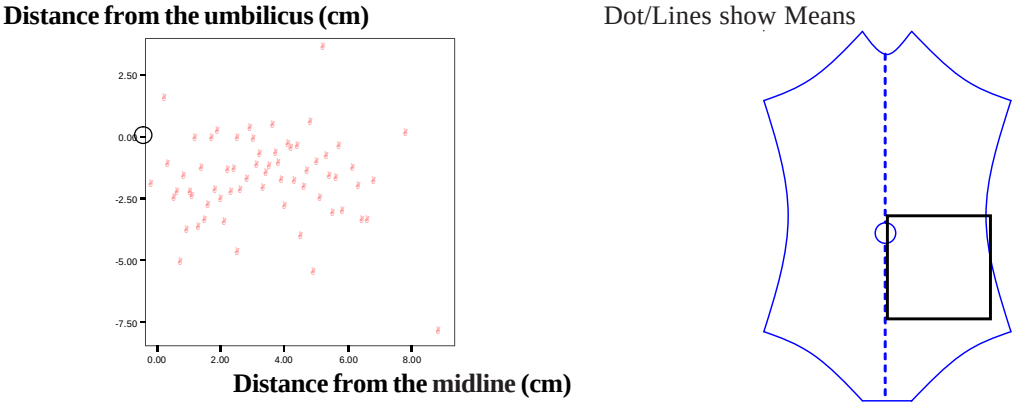

Fig. 2 The distribution of all 405 perforators over the anterior rectus sheath. The umbilicus and the midline are landmarks. These perforators are concentrated within 3 cm below and within 7 cm horizontally from the umbilicus

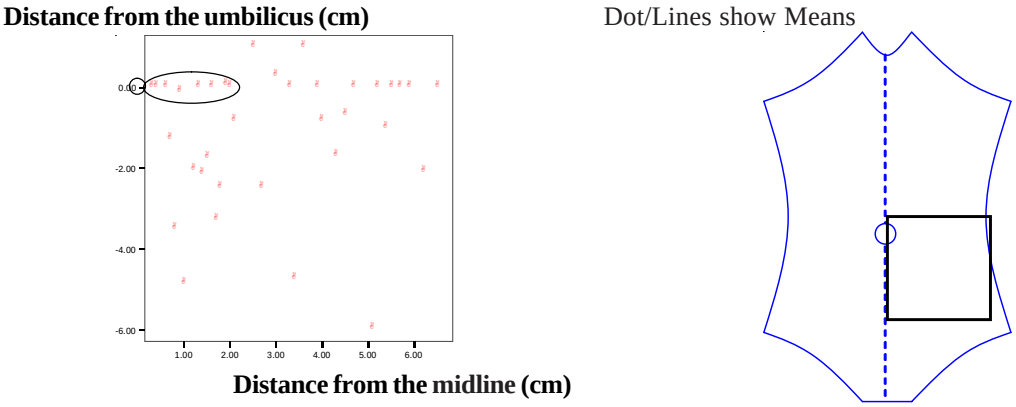

Fig 3.1 The distribution of 62 largest perforators over the anterior rectus sheath. The umbilicus and the midline are landmarks. The largest perforators usually are in the same level horizontally of the umbilicus. The number of perforators is the greatest in the medial row

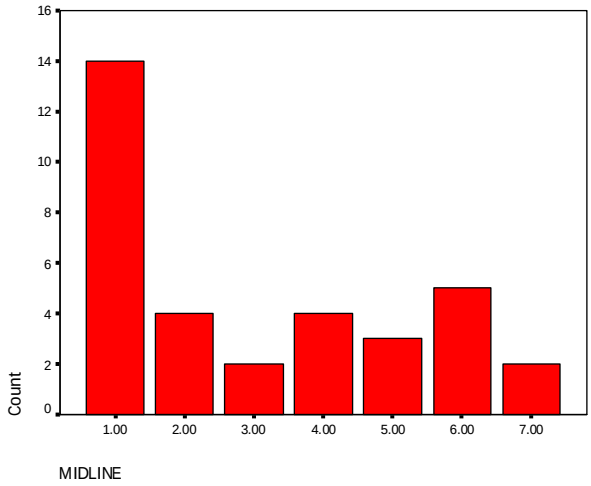

Fig. 3.2 The number of the largest perforator lying horizontally from the umbilicus

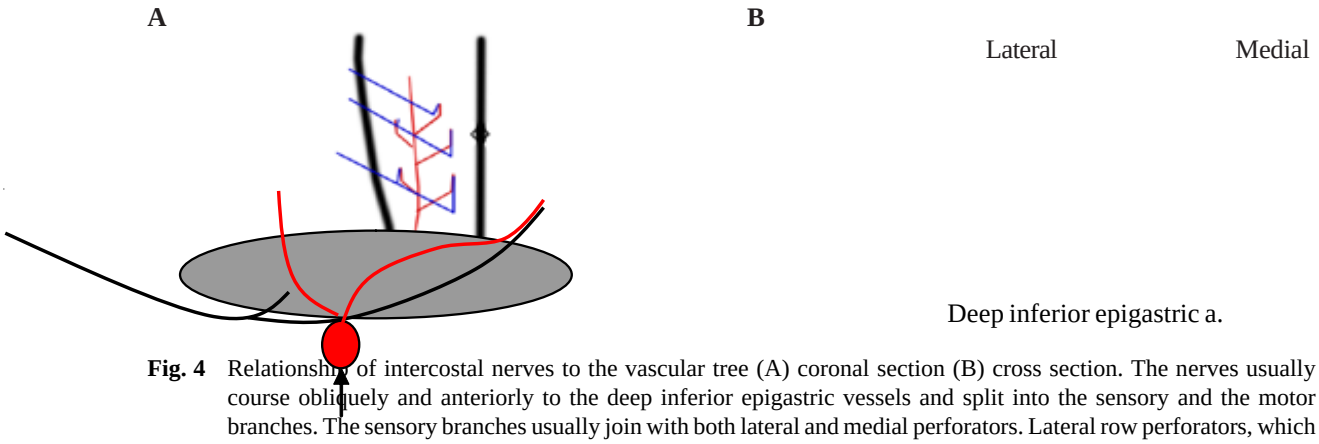

Fig. 4 Relationship of intercostal nerves to the vascular tree (A) coronal section (B) cross section. The nerves usually course obliquely and anteriorly to the deep inferior epigastric vessels and split into the sensory and the motor branches. The sensory branches usually join with both lateral and medial perforators. Lateral row perforators, which are usually in rectilinear course, travel with nerves from the beginning. Whereas medial row perforators, which usually traveling in oblique course, are not related to nerves initially but they join together before piercing to the anterior rectus sheath

virtues of the deep inferior epigastric flaps have been described earlier, but these were lots of variations.

In the present study, the largest number of complete data of anatomical dissections from 62 flaps was presented and the results compared with those of previous studies leading to select the locations of the neurovascular perforators for DIEP flap harvesting.

1. The deep inferior epigastric pedicle

1.1 The pattern of the pedicle

Anatomic assessment of the deep inferior epigastric artery running within the rectus abdominis muscle was reported by Itoh and Arai[9], Brian Boyd et al[28], and by Offman et al[29]. They described the deep inferior epigastric artery giving of a branch running slightly laterally and another running medially to the muscle midline.

Contrasting with the above anatomical studies, Frank[30] described from large dissections that the most frequent pedicle as a single-stem vessel passed superiorly on the posterior aspect of the rectus muscle. In the present study, similar results were obtained, after deep inferior epigastric artery entered the muscle, a single main stem was found in 43 flaps (68.3%). The remaining 19 flaps (31.7%) were with double main stems. The different finding was probably

due to the lower number of specimens of previous studies than those of Frank and of the present study.

1.2 The length and diameter of pedicle

Table 5 shows the average length and diameter of the pedicle found by Heitmann[10], Allen and Treece[13], and Offman et al[29]. They did not emphasize the medial branch and the lateral branch. Whereas the present study reported the length and diameter of the pedicle into two parts (Table 6). One was part of a single pedicle and the other was a double pedicle. The lateral division was the dominant branch (larger diameter and longer length) in the majority of cases (15 cases from 19, 79%), whereas the medial branch was only dominant in four cases from 19 (21.1%). However, comparing the length and diameter of the lateral branch to the medial branch demonstrated no significant difference ($p > 0.05$). Therefore, it does not make any difference when using the lateral branch or the medial branch in DIEP flap harvesting. In contrast, the study of Itoh and Arai[9], indicated that it seemed more efficient if the flap used the skin perforator belonging to the lateral branch because the lateral branch was dominant over the medial branch. However, they did not give any data concerning the length and the diameter of the pedicle.

2. The perforators

Although several authors gave number, location, course, and distribution of perforator vessels in the lower abdominal wall vascularization, there is no detailed anatomical study regarding the location and diameter of the largest perforator.

2.1 The number of perforators

In the present study, four hundred and five perforator vessels were dissected from 62 DIEP flaps. Therefore, it is obvious that the deep inferior epigastric perforators are not difficult to find (6.5 vessels per flap). This finding is similar to those of Alexandre[3], Itoh and Arai[9], Hamdy[14], and Offman et al[29] as shown in Table 7.

2.2 The location of the perforators

In the present results, three vertical rows of perforator vessels were observed along the anterior rectus abdominis sheath, first in the lateral third,

Table 5. The length and diameter of pedicle

Year	Author	No. of Cadaver	Length (cm)		Diameter (mm)	
1994	Allen & Treece[13]	8		11.8		4.3
2000	Heitmann et al[10]	20		10.3*		3.6**
2005	Offman et al[30]	5		7.5-20.5		3.3**
2005	Present study	31	- Single	11.7±2.2***	- Single	3.2±0.4****
			- Double		- Double	
			Medial	7.6±2.7*****	Medial	2.1±0.4*****
			Lateral	9.3±2.6*****	Lateral	2.3±0.4*****

* distance from origin to the most distant perforator
** at its origin
*** distance from its entry into the lateral border of the muscle to the most distant perforator
**** at the lateral border of the muscle
***** at its bifurcation

Table 6. The number of the perforators

Year	Author	Number of cadaver	Number of perforator per flap
1993	Itoh and Arai[9]	17	6.5 perforators/flap
2002	Hamdy et al[14]	20	5.4 perforators/flap
2004	Alexandre et al[3]	15	6.4 perforators/flap
2005	Offmann et al[30]	5	5 perforators/flap
2005	Present study	31	6.5 perforators/flap

Table 7. The location of the perforator

Year	Author	Number of cadaver	Concentrated location of perforator	
1993	Itoh and Arai[9]	17	Middle-Lateral	-
2000	Hamdy et al[14]	20	Inferior-Lateral	-
2004	Alexandre et al[3]	15	Medial row	66%
2005	Offmann et al[30]	5	Peri-umbilical	-
2005	Present study	31	Medial row	45.4%

second in the middle third and other in the medial third of the muscle. These perforators were mostly contained in the medial third (45.4%). The present finding is similar to those of Alexandre[3] and Offman et al[29] that perforators are concentrated in the peri-umbilical region but differs from that of Itoh and Arai[9], who found that the number of skin perforators was the greatest in the middle-lateral from umbilicus. It also differs from that of Hamdy [14], who found that the perforator were mostly contained in the area lying laterally and below the umbilicus, with an average distance of 4 cm from umbilicus. In addition, the authors were concerned about external diameter of perforators. The authors found that the lateral row perforators were the largest external diameter (1.0 ± 0.3 mm) but not significantly different among the diameter of the lateral, the medial, and the intermediate perforators ($p > 0.05$). Therefore, it does not make a difference when using the lateral or the medial or the intermediate perforators. Moreover, the location and external diameter of the largest perforator of each flap were observed. The largest perforator in each flap had an external diameter with an average of 1.4 ± 0.3 mm and it was mostly found within 1 cm horizontally from the umbilicus (Fig. 3.2). This area is very close to the umbilicus. During flap harvesting, preservation of the umbilicus will increase risk of vascular injury. Therefore, the second largest perforator, with the average diameter of 1.1 ± 0.2 mm and usually within 2.5 cm below the umbilicus of the lateral third row, should be chosen for DIEP flap harvesting.

2.3 The intramuscular course

According to the present results, the lateral row perforators were usually with rectilinear course (82.7%). Whereas, the perforators in the medial row were usually oblique (86.4%). The dissection was more tedious, requiring extensive longitudinal splitting of the rectus muscle. Therefore, the lateral row perforator is selected during DIEP harvesting for it will be easier to dissect and, in most cases, this vessel runs perpendicularly through the rectus muscle. The muscle was split in a longitudinal direction without muscle resection. The present finding is similar to the study of Alexandre[3].

3. The relationship of the nerve to vascular perforators

In the present study, it was found that nerves usually ran obliquely and anteriorly to the deep inferior epigastric vessels and split into the sensory and the motor branches. The motor branches were spread to innervate the muscle. The sensory branches can join with the lateral, the intermediate and the medial vascular perforators of the deep inferior epigastric vessels. Some of the cutaneous branches from the 11^{th} and the subcostal nerves did not travel with perforator but pierced alone. They were usually in the lower part of the rectus abdominis. It seems that this region may be supplied by the superficial inferior epigastric artery. This finding has not been previously reported. The sensory branches that join with the lateral and the medial perforators are the most frequent type (50%). These findings are similar to those of Boyd and Taylor [28] that the mixed nerves ran obliquely and anteriorly to the deep inferior epigastric vessels in most people and split into the sensory and the motor branches at variable distances. The pure sensory branches joined with the perforating vessels to supply the skin. In contrast, Yap et al[19] reported that the nerves were closely related to the deep inferior epigastric vascular axis, and might lie either anterior or posterior to the vessels, depending on the level of the nerve, with the higher nerves in the series usually lying posterior. While lower nerves tended to lie anterior to the vessels (Fig. 5). In the present study, it was not found that the nerves cross the deep inferior epigastric vascular axis posteriorly. The present findings also imply that lateral row perforators, which usually were rectilinear course, will travel with nerves from the beginning. Whereas medial row perforators, which usually were oblique course, were not related to nerves initially but they jointed together before piercing the anterior rectus

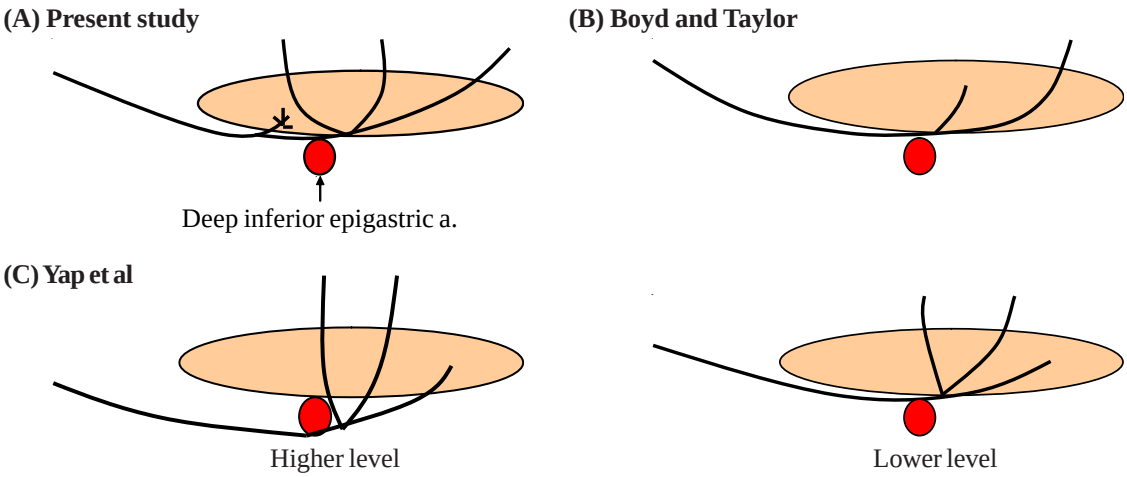

Fig. 5 Relationship of the intercostal nerve to the pedicle. (A) Note all of the nerves run anteriorly to the deep inferior epigastric vessels before splitting into the sensory and the motor branch. The sensory branches joined with the lateral, the intermediate and the medial vascular perforators. (B)[28] The mix nerves run anteriorly to the deep inferior epigastric vessels in most cadavers and split into the sensory and the motor branches. (C)[19] The nerves might lie either anterior or posterior to the vessels, with nerves higher in the series usually lying posterior. While lower nerves tend to lie anterior to the vessels

sheath (Fig. 4B). Yap et al[19] did not mention this relationship. Therefore, it is suggested that the lateral neurovascular perforator should be chosen for DIEP flap harvesting because nerve and vessel ran together through the course. This would be easy to dissect and minimize the damage to muscle, nerve and vessels. Whereas, Yap et al[19] suggested that one way to maximize the area of skin innervated by the selected nerves would be to include both medial and lateral neurovascular perforator. This procedure requires a full transaction of the muscle.

In the past decade, the DIEP flap has become the preferred choice for breast reconstruction. Paul[31] examined 758 DIEP flap between August of 1992 and August of 2002. They found only 19 cases (2.5 percents) of partial flap loss and four cases (0.5 percent) of total flap loss. Patients with 45 flaps (5.9 percent) were returned to the operating room before the second-stage procedure. Twenty-nine flaps (3.8 percent) were revised because of venous congestion. Complication rates in this large series were comparable to those in retrospective reviews of pedicle and free TRAM flap. Previous studies of the free TRAM flap [32-34] described breast complication rates ranging from 8 to 13 percent and abdominal complication rates ranging from 0 to 82 percent. It was noted that, with experience in microsurgical techniques and perforator selection, the DIEP flap offers distinct advantages to patients, in terms of decreased donor-site morbidity and shorter recovery periods.

The DIEP flaps were used in patients to cover various defects, 14 patients were reconstructed with free DIEP flap by Kostakoglu and Kecik[35]. The defects were located on the upper limb in four, the lower limb in nine, and the scalp and forehead in the remaining two cases. Two flaps were lost due to venous thrombosis. Tip necrosis was observed in two flaps. The remaining 11 flaps survived completely. Itoh and Arai[9] used DIEP flap in 21 patients with calcaneal, thigh, hand, foot, forearm, neck, facial, ankle, forehand, and scalp defects. All patients had a complete survival flap.

Conclusion

The present study suggests that it would be more beneficial to use the lateral row perforators, which is located within 2.5 cm below the umbilicus, rather than the medial row or intermediate row perforators during DIEP flap harvesting. This is because 1) second large perforators are usually in the lateral row, concentrating within 2.5 cm below the umbilicus, 2) lateral row perforators are usually in the rectilinear course, and 3) lateral sensory nerves travel with lateral row perforators through the course. Thus, the anatomical features of the lateral row perforator vessels favor the dissection to reduce operating time and risk of vessel and nerve injury.

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กายวิภาคของระบบประสาทและหลอดเลือดของ ดีพ-อินเฟียเรียะ- เอพิแกซทริก-เพอโฟเรเทอะ-แฟล็บ เพื่อประยุกต์ใช้ในการผ่าตัดเต้านม

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วัตถุประสงค์*: เพื่อหาเพอโฟเรเทอะและเส้นประสาทที่เหมาะสมสำหรับการนำไปประยุกต์ใช้ในการผ่าตัด ดีพ-อินเฟียเรียะ- เอพิแกซทริก-เพอโฟเรเทอะ-แฟล็บ*

วัสดุและวิธีการ*: ทำการชำแหละศพ 31 ศพ โดยศึกษาถึงลักษณะของ ดีพ-อินเฟียเรียะ- เอพิแกซทริก เพดดิเคล, เพอโฟะเรเทอะ และ เส้นประสาท อินเทอคอสทอล รวมทั้งความสัมพันธ์ระหว่างเส้นประสาทและหลอดเลือดในแต่ละตัวอย่าง*

ผลการศึกษา*: เพอโฟเรเทอะทั้งหมด 405 เส้นถูกแบ่งออกเป็น 3 กลุ่ม โดยเพอโฟเรเทอะจะ หนาแน่นที่สุดในบริเวณ 1/3 ทางด้านในของกล้ามเนื้อ (45.4%) และ เพอโฟเรเทอะ ที่อยู่บริเวณ 1/3 ทางด้านนอก จะมีขนาดเฉลี่ยใหญ่ที่สุด คือ 1.01 $\pm$ 0.26 มม.ส่วนเพอโฟเรเทอะเส้นที่ใหญ่ที่สุด(1.4 $\pm$ 0.3 มม.) ในแต่ละแฟล็บมักจะอยู่ภายในบริเวณ 1 ซม. ห่างจากสะดือ เพอโฟเรเทอะในกลุ่มแลทเทอรอล ส่วนใหญ่จะมีลักษณะเป็น เรคทายลีเนีย คอส (82.7%) และพบเส้นประสาทวิ่งคู่มาด้วยตลอดเส้นทาง ในขณะที่ มีเดียล เพอโฟเรเทอะ มักเป็นแบบ ออบลีค คอส (86.4%) และเส้นประสาท ที่ไปกับ มีเดียล เพอโฟเรเทอะ นั้นจะไม่ได้ทอดตัวคู่กันตลอดเส้นทาง แต่จะมาคู่กัน ณ ตำแหน่งที่แทงสู่ เรคตัส ชีท*

สรุป*: ผลการศึกษาพบว่าจะเป็นผลดีมากกว่าในการเลือกใช้ แลทเทอรอล เพอโฟเรเทอะ ในการผ่าตัด*