

# DISSECTION GUIDE 2017



15th Annual

## Duke Flap Course

August 4–6<sup>th</sup>, 2017  
Durham, North Carolina

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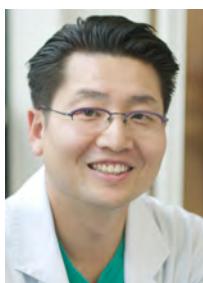
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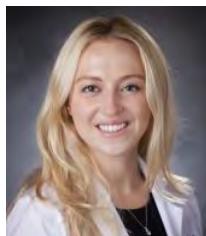
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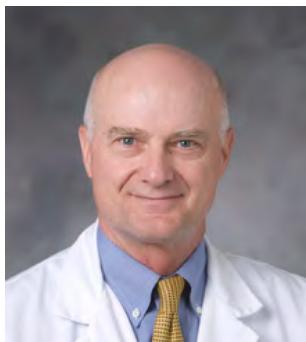


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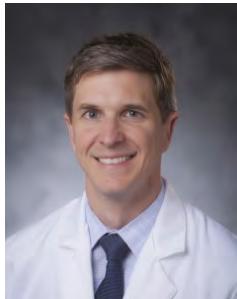
**Steve Wilson - Assistant Lab Manager**



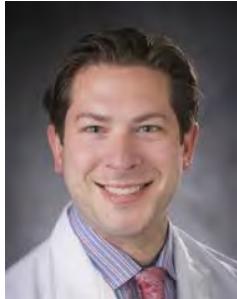
**Jessica Chmielewski - Lab Assistant**

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Images from "Reconstructive Surgery-Anatomy, Technique, and Clinical Applications" (Zenn/Jones) courtesy of Thieme Medical Publishers

## Flap: Latissimus Dorsi Flap

**Tissues available:** muscle, skin, 10<sup>th</sup> rib

**Vascular Anatomy:** thoracodorsal artery(2-4mm), vein (2-5mm); pedicle length 8 cm, which can be lengthened by including subscapular trunk; paravertebral perforators (minor vascular supply)

**Innervation:** thoracodorsal nerve (motor), lateral cutaneous branches of the intercostal nerves(sensory)

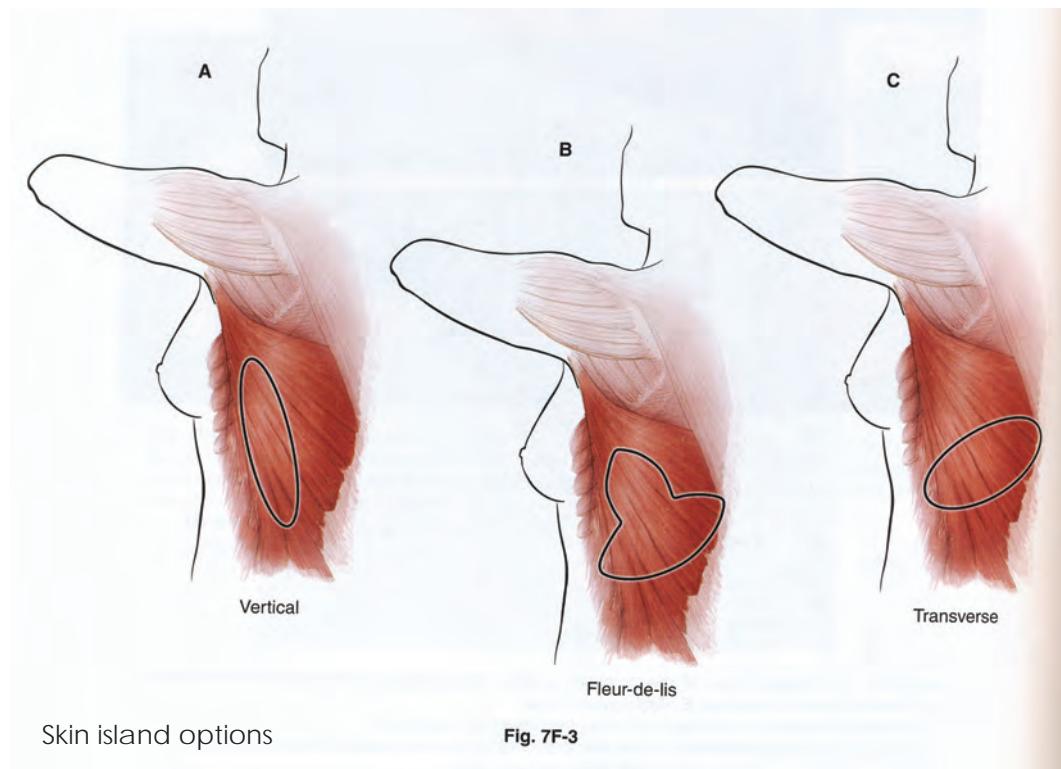
**Flap Dimensions:** 9x22 cm (primary closure), 22x35cm (skin graft donor site)

**Advantages:** large size, long pedicle (15 cm); can be a functional transfer

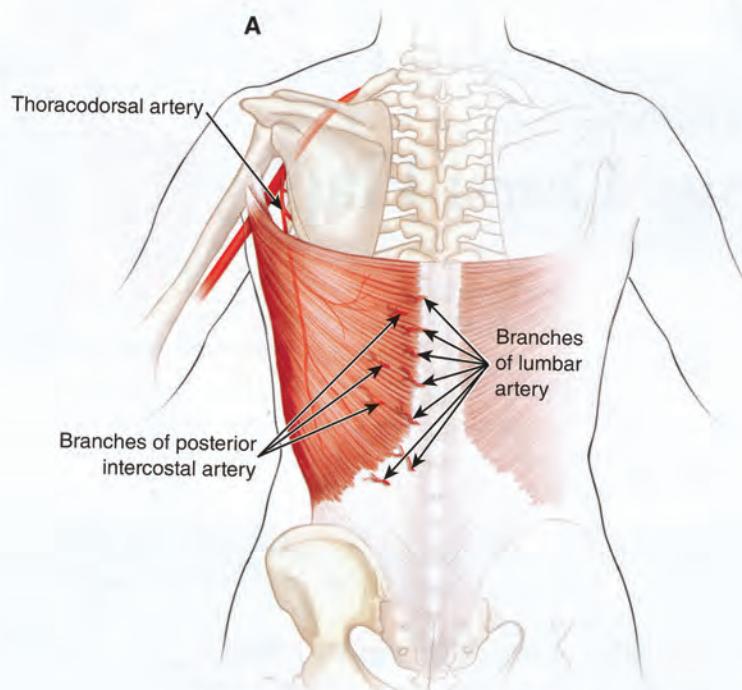
**Disadvantages:** need lateral positioning; large scar (less if endoscopic); functional shoulder loss, not usually clinically noticeable

**Things to note:** chimeric flaps possible with subscapularis axis flaps(serratus, parascapular,etc.); possible to raise skin as perforator flap (TDAP); rib viability raised with flap questionable; can raise flap on minor paravertebral perforators as turnover flap

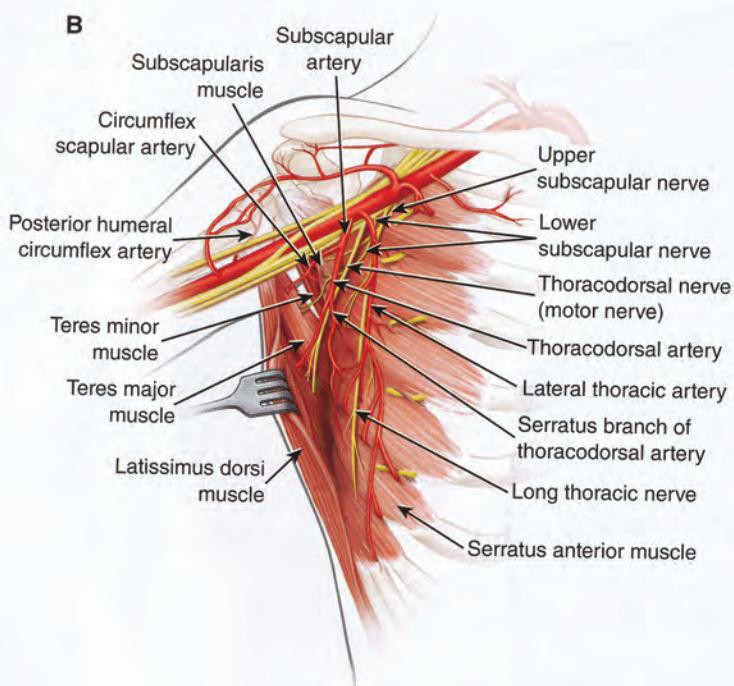
**Notes:**



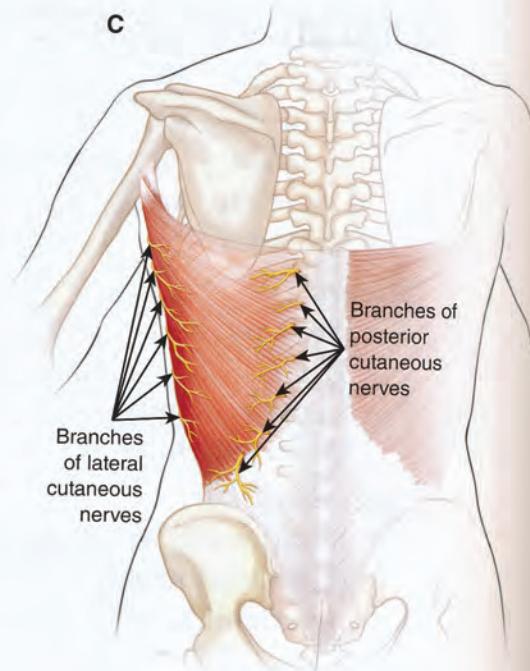
## ANATOMY OF THE LATISSIMUS DORSI FLAP



Arterial supply to the latissimus dorsi muscle



Neurovascular anatomy of axilla



Sensory innervation to overlying skin

**Fig. 7F-1**

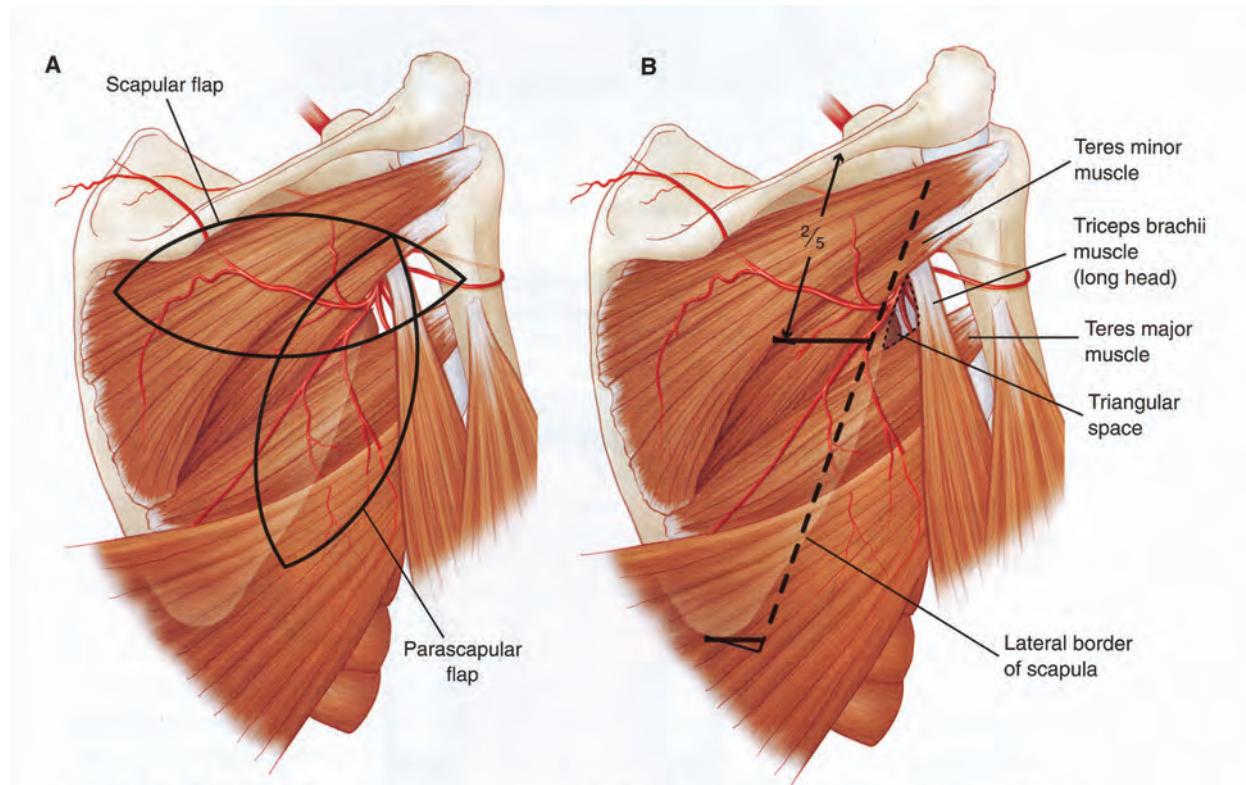
**Dominant pedicle:** Thoracodorsal artery

**Minor pedicles:** Segmental paraspinal perforators; perforator of lumbar artery

## Flap: Scapular/Parascapular Flap

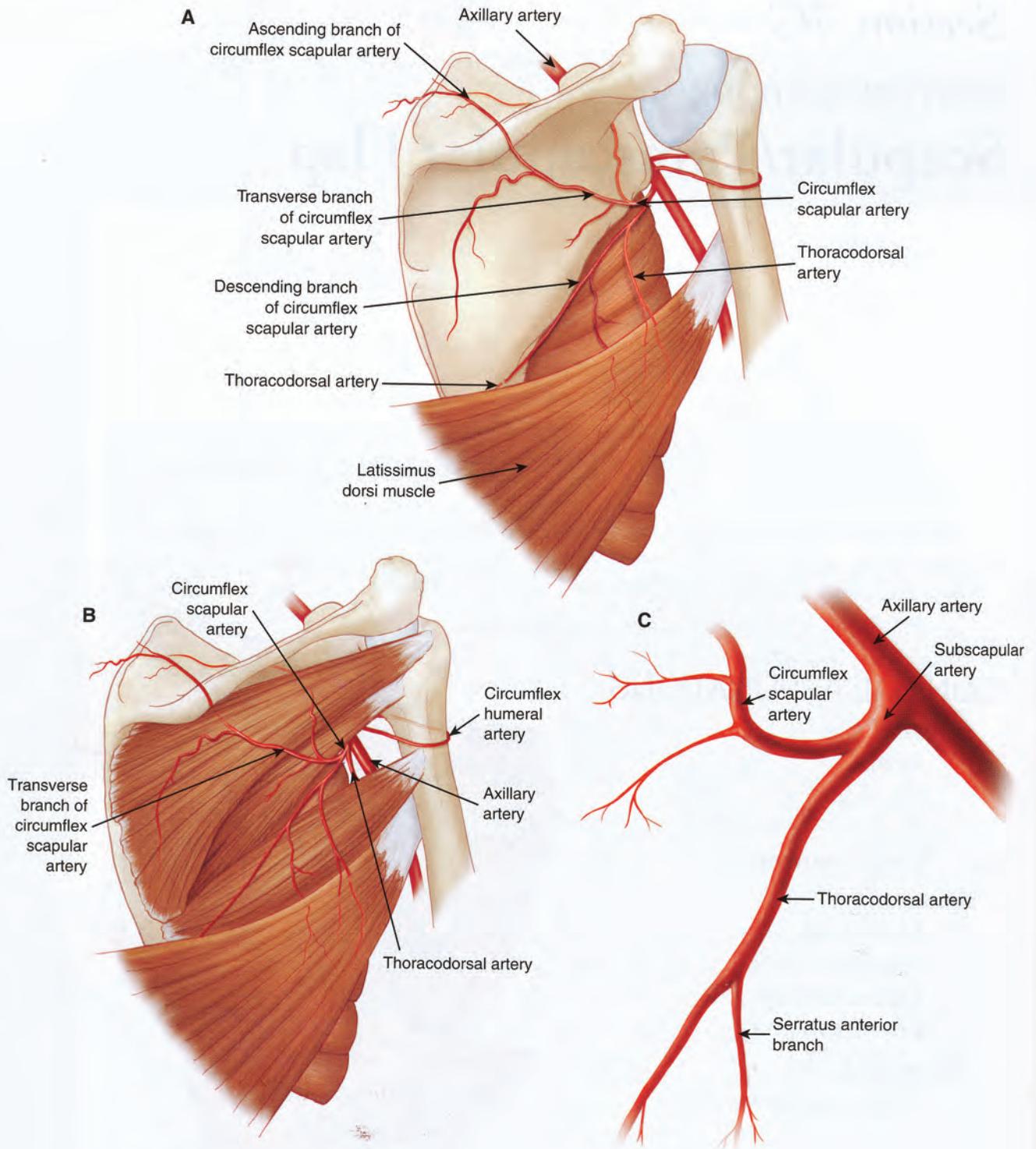
<b>Tissues available:</b>	skin, adipofascial, bone
<b>Vascular Anatomy:</b>	circumflex scapular artery(1.5-3.0mm) and vena comitantes(2-4mm)
<b>Innervation:</b>	intercostal (medial aspect of flap)
<b>Flap Dimensions:</b>	20x 5 cm
<b>Advantages:</b>	abundant tissue available, still allowing primary coverage; fascial extensions for facial contouring;
<b>Disadvantages:</b>	lateral or prone for harvest; bulky in some patients
<b>Things to note:</b>	doppler vessels in triangular space; pedicled flap reaches axilla

Notes:



**Fig. 7C-3** **A**, Outline of the scapular and parascapular flaps based on the scapular cutaneous artery and parascapular cutaneous artery, respectively. These are both terminal branches of the descending branch of the circumflex scapular artery, seen exiting through the triangular space. **B**, The triangular space can usually be identified by palpation. An approximate location can be marked at the lateral border of the scapula, two fifths the distance inferiorly on a line connecting the midportion of the spine of the scapula to its inferior angle.

## ANATOMY OF THE SCAPULAR/PARASCAPULAR FLAP



**Fig. 7C-1** **A**, The blood supply of the scapular system. **B**, The circumflex scapular artery is seen exiting the triangular space. The orientations of the four major dorsal thoracic fascia flaps are outlined, each based on its discrete and usually consistent tributary: anterior (inframammary extended circumflex scapular); ascending (ascending scapular); descending (parascapular); horizontal (scapular). **C**, The subscapular artery arises from the third portion of the axillary artery on its inferior margin. It divides into the circumflex scapular artery and the thoracodorsal artery.

**Dominant pedicle:** Circumflex scapular artery

## Flap: Gluteus Maximus Flap

**Tissues available:** skin, fat, muscle

**Vascular Anatomy:** superior gluteal artery(2-3mm) and vein(3-4mm); pedicle 2 cm  
inferior gluteal artery(2-2.5mm) and vein(3-3.5mm); pedicle 6 cm

**Innervation:** inferior gluteal nerve (motor); no sensory nerve with flap

**Flap Dimensions:** 13x30cm

**Advantages:** available donor site in most patients; hidden donor scar; minimal functional deficit if less than 1/3 of muscle is harvested

**Disadvantages:** must harvest in lateral or prone position, sometimes necessitating position change during case; contour deformities may require revision and contralateral contour procedures; donor site seromas common; thigh numbness may result from injury to the posterior femoral cutaneous nerve with inferior gluteal flap harvest

**Things to note:** superior territory may be carried as a skin only perforator flap (S-GAP), which helps to lengthen the effective pedicle length; inferior territory can be carried as an I-GAP as well. functional muscle transfer for anal incontinence possible

**Notes:**

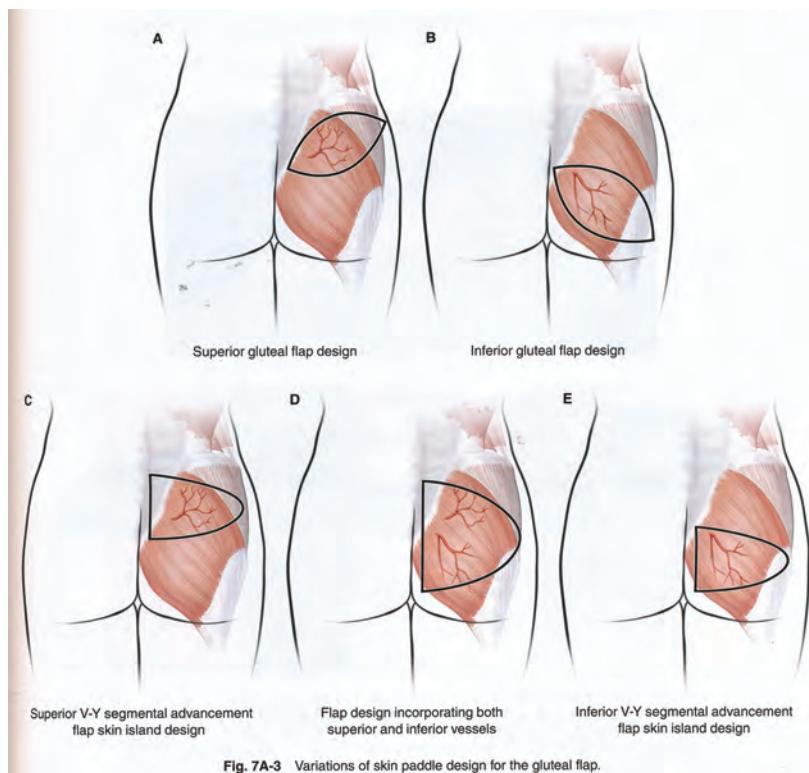
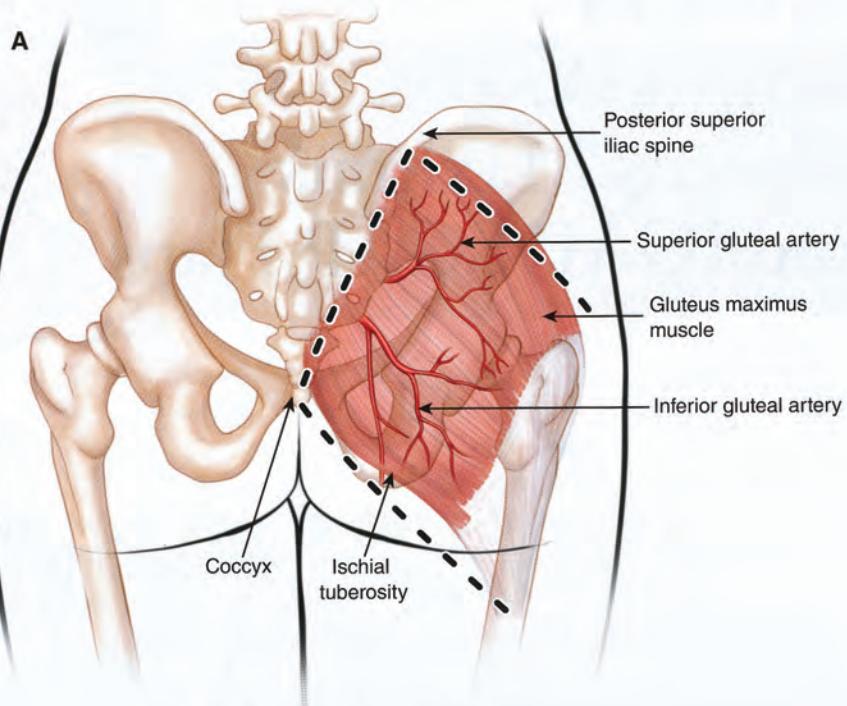
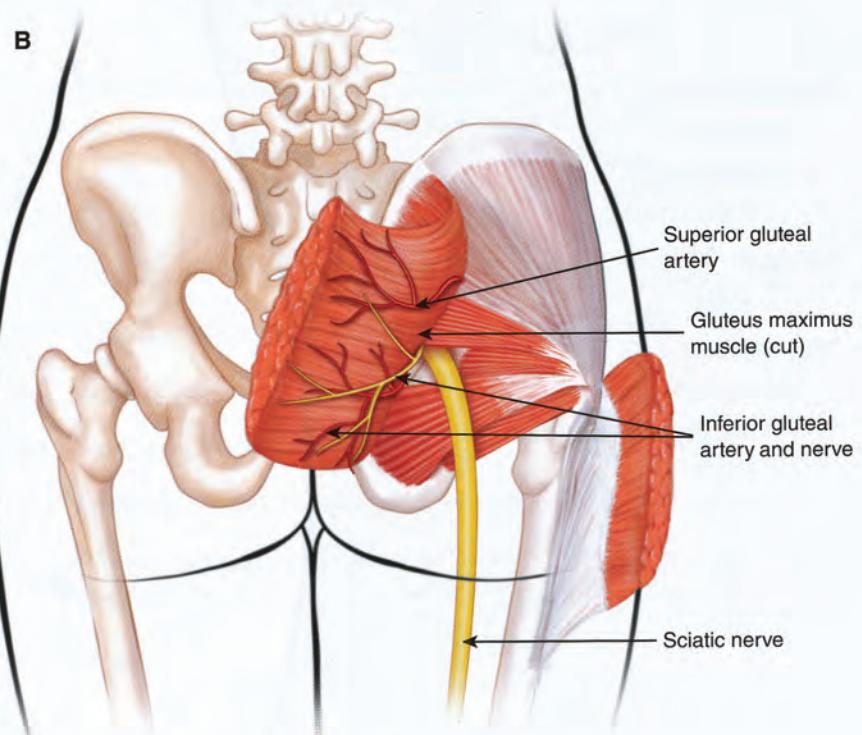


Fig. 7A-3 Variations of skin paddle design for the gluteal flap.

ANATOMY OF THE GLUTEUS MAXIMUS AND IGAP/SGAP FLAPS



Bony landmarks of gluteus muscle



Undersurface of muscle with neurovascular anatomy

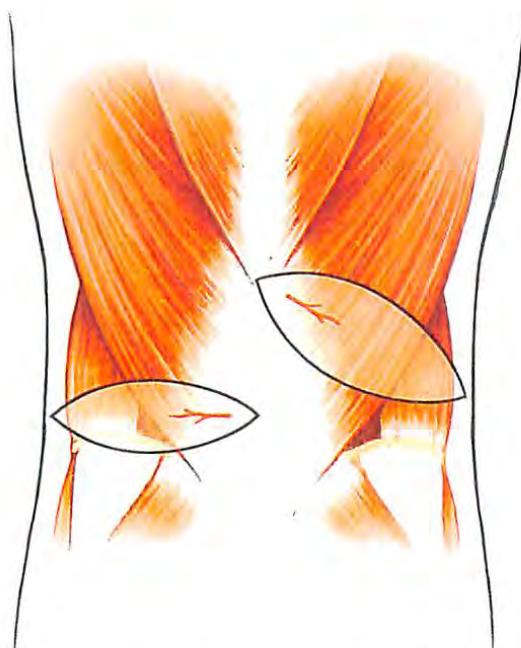
Fig. 7A-1

**Dominant pedicles:** Superior gluteal artery; inferior gluteal artery

## **Flap: Lumbar Perforator Flap**

<b>Tissues available:</b>	skin, fat
<b>Vascular Anatomy:</b>	Lumbar perforating arteries from aorta (L1 to L4); iliolumbar arteries (L5)
<b>Innervation:</b>	Sensroy: Superior cluneal nerves (L1 to L3)
<b>Flap Dimensions:</b>	15 x 24 cm
<b>Advantages:</b>	potential to supply large amount of fatty volume for breast reconstruction
<b>Disadvantages:</b>	short pedicle (2 to 3 cm) and small diameter artery (1mm)
<b>Things to note:</b>	Pre-operative CT angiography provides accurate determination of perforators, skin paddle is orientated horizontal, may be harvested in supine or lateral decubitus position.

**Notes:**



Lumbar flap design for second and fourth perforators

Fig. 7D-3

### ANATOMY OF THE LUMBAR PERFORATOR FLAP

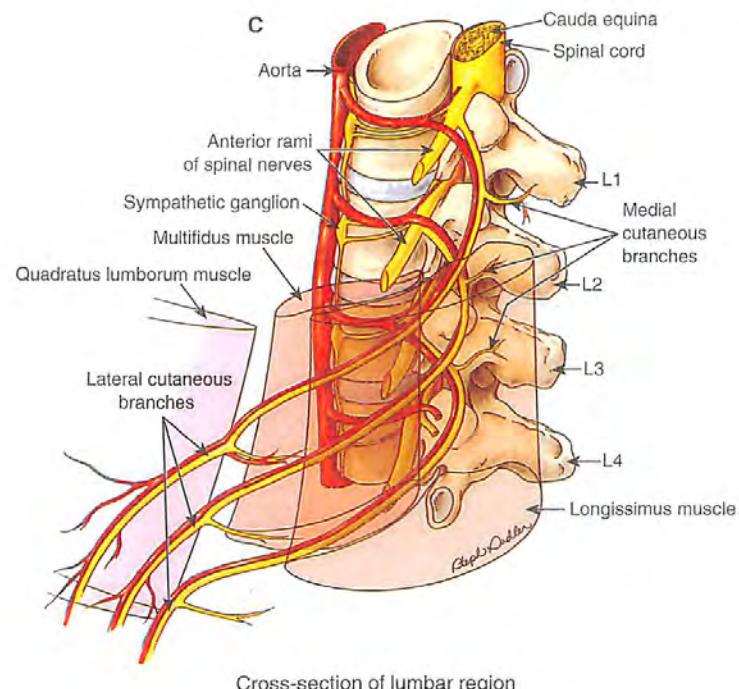
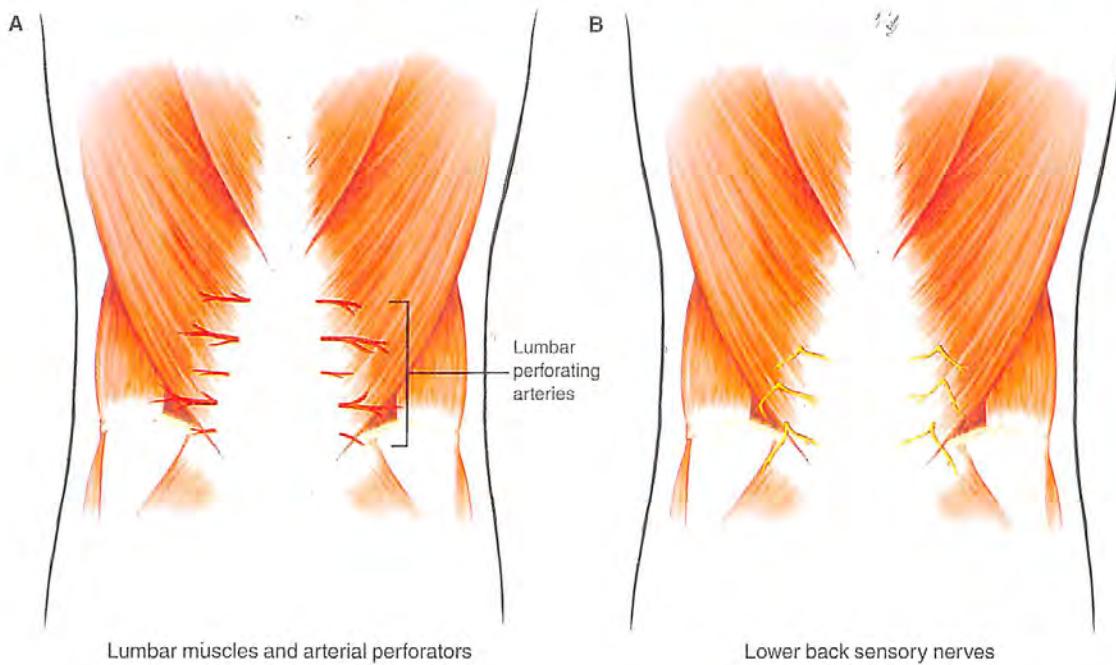


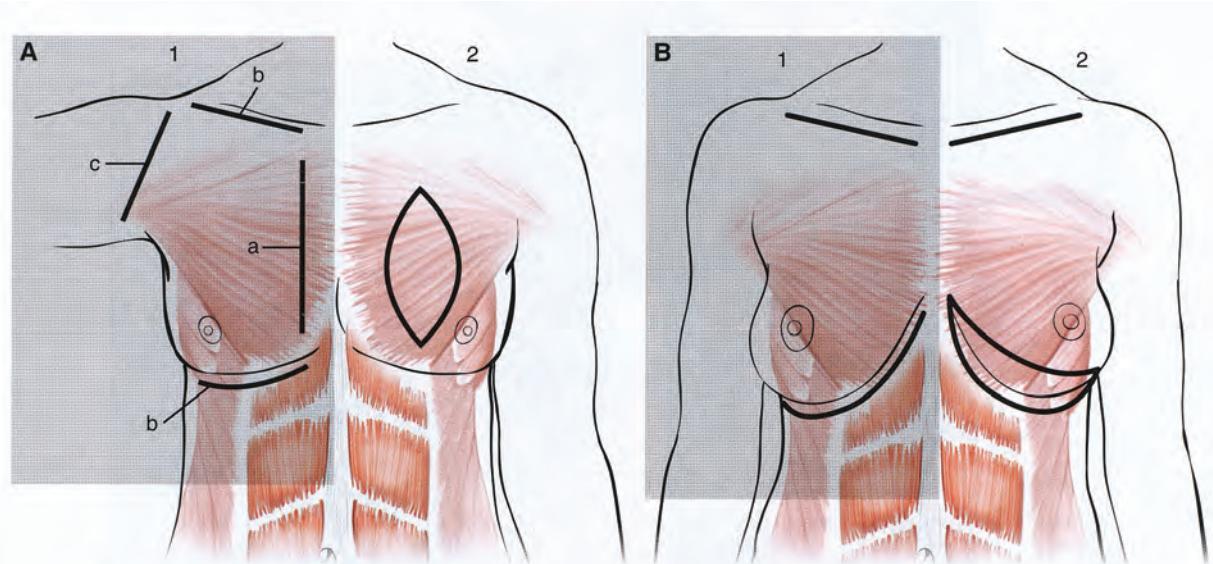
Fig. 7D-1

Dominant pedicle: Lumbar perforating arteries (L1-L5)

## Flap: Pectoralis Major Flap

<b>Tissues available:</b>	muscle, skin, rib or clavicle
<b>Vascular Anatomy:</b>	thoracoacromial artery(2 mm) and vein(3-4mm) and internal mammary perforating vessels from the second to fifth intercostal spaces; the flap may survive on either blood supply; thoracoacromial pedicle length is 3 cm
<b>Innervation:</b>	medial (lower half of muscle)and lateral pectoral (upper half of muscle) nerves (motor); intercostal and supraclavicular nerves (sensory)
<b>Flap Dimensions:</b>	8 x 15 cm skin paddle with primary closure
<b>Advantages:</b>	favorable access of rotation for head & neck and sternal uses; simple harvest; no functional loss; available for intrathoracic transposition;
<b>Disadvantages:</b>	donor site contour
<b>Things to note:</b>	skin territory extends only 2 cm below muscle origin inferiorly; leave inferior lateral muscle strip to maintain anterior axillary fold cosmesis

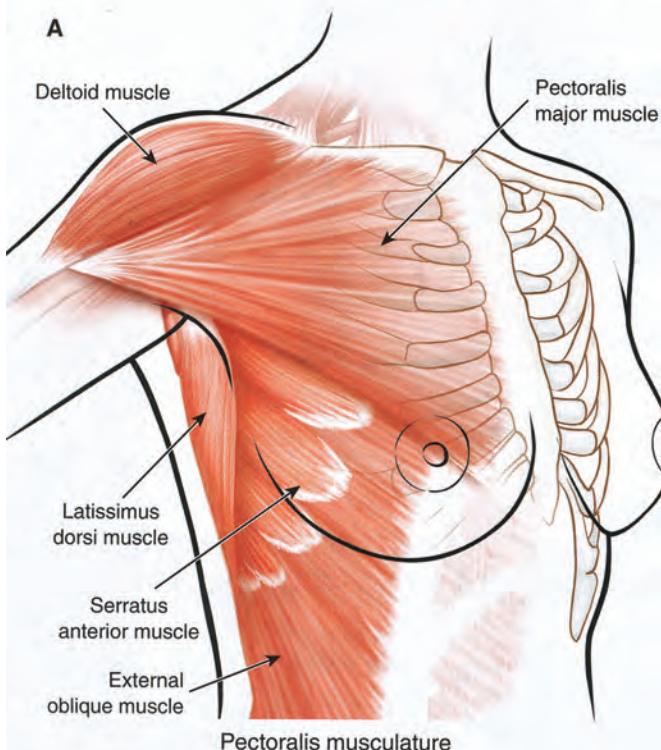
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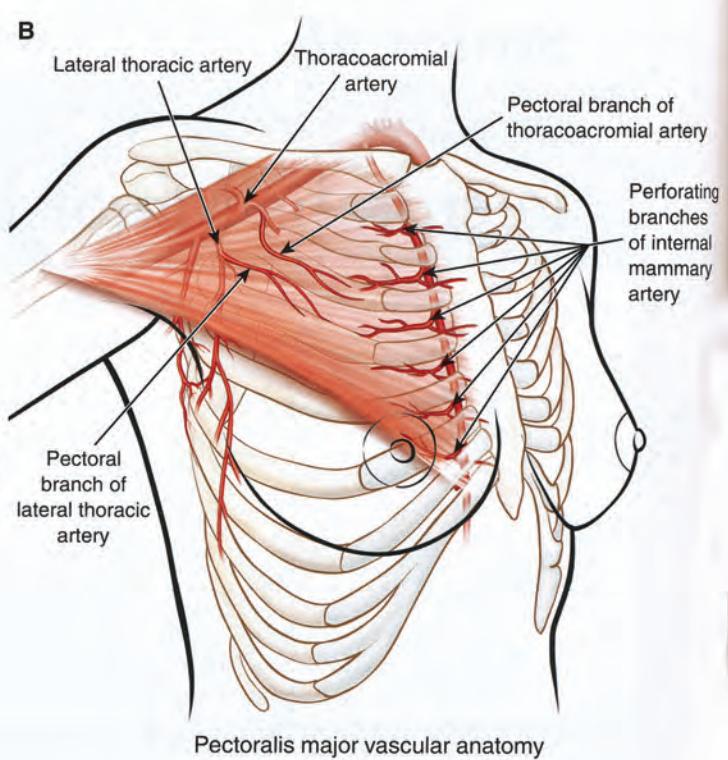
**Fig. 6E-3** Skin island designs for head and neck coverage. **A**, 1: a, For access to muscle for reverse flap based on the mammary perforating vessels. b, Access incisions for muscle-only harvest for head and neck reconstruction, leaving the deltopectoral flap available for future use. c, Deltopectoral incision to release the muscle origin for use with a and possibly b. 2: Typical vertical skin design used in men. **B**, 1: Access incisions for muscle-only harvest for head and neck reconstruction, sparing the breast and leaving the deltopectoral flap available for future use. 2: Typical skin design in women to avoid taking breast tissue with the flap and to minimize donor site deformity.

### ANATOMY OF THE PECTORALIS MAJOR FLAP

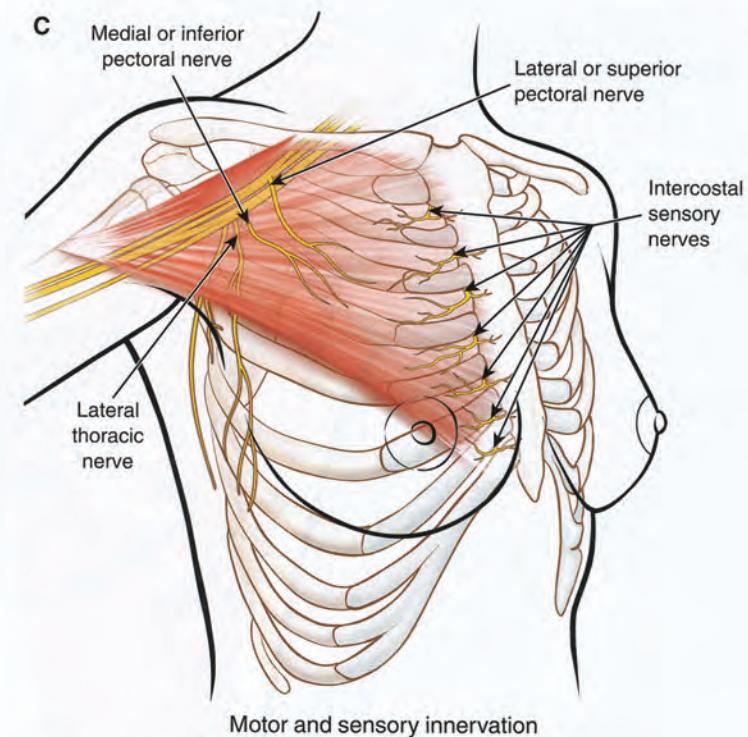
**A**



**B**



**C**



**Fig. 6E-1**

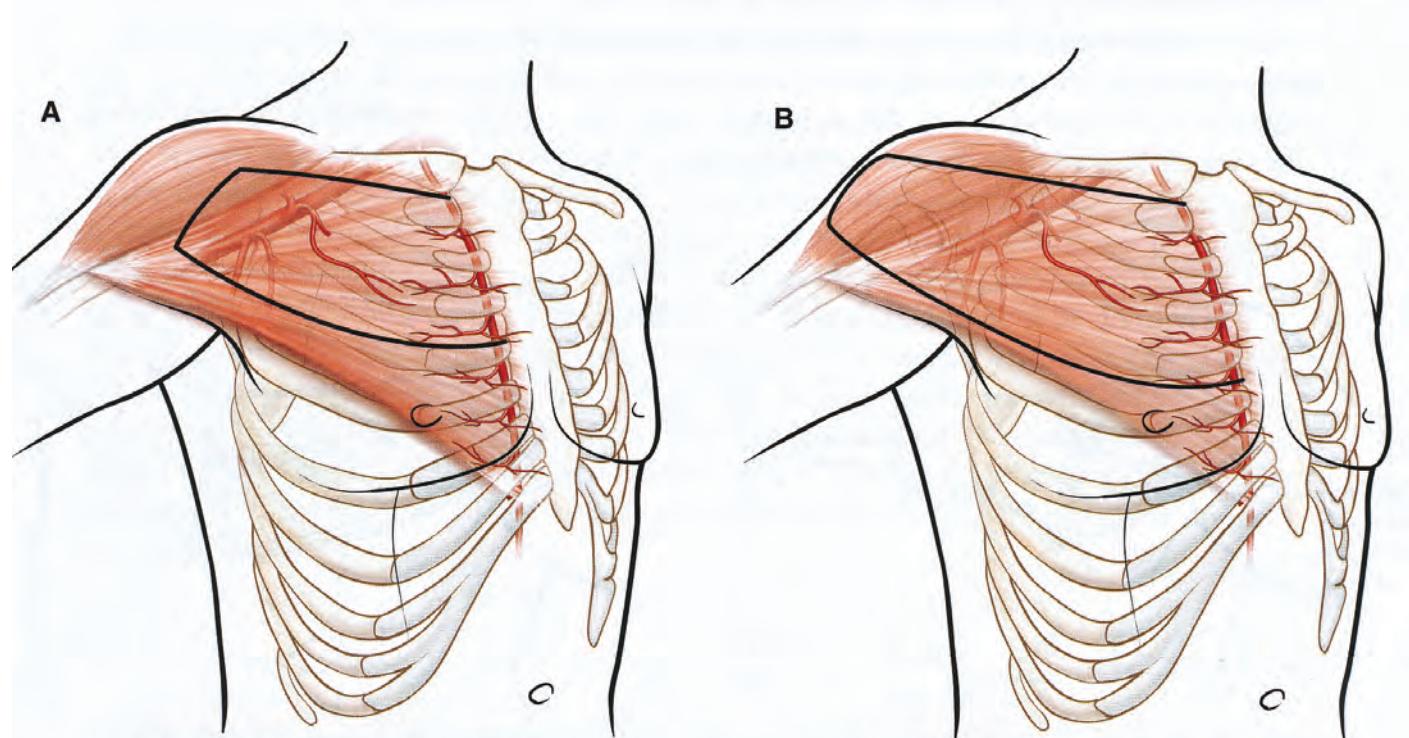
**Dominant pedicle:** Pectoral branch of thoracoacromial artery

**Minor pedicles:** Perforating branches of internal mammary artery

## **Flap: Deltpectoral / IMAP Flap**

<b>Tissues available:</b>	skin
<b>Vascular Anatomy:</b>	internal mammary perforating vessels (2 <sup>nd</sup> ,3 <sup>rd</sup> ,and 4 <sup>th</sup> intercostal spaces); arteries(0.8-1.2mm), veins(1.5-2.5mm)
<b>Innervation:</b>	anterior intercostal nerves
<b>Flap Dimensions:</b>	10x20 cm
<b>Advantages:</b>	favorable arc of rotation for head & neck reconstruction; thin, pliable tissue; good color match to face
<b>Disadvantages:</b>	donor deformity if skin grafting required; may deform breast in female; possible need for secondary division and inset required
<b>Things to note:</b>	can extend territory beyond deltopectoral groove by delay procedures; free flap described; as free flap can extend pedicle length by removing ribs and including internal mammary vessels with flap (artery 2-3mm, vein 1.5-3.5mm)

**Notes:**

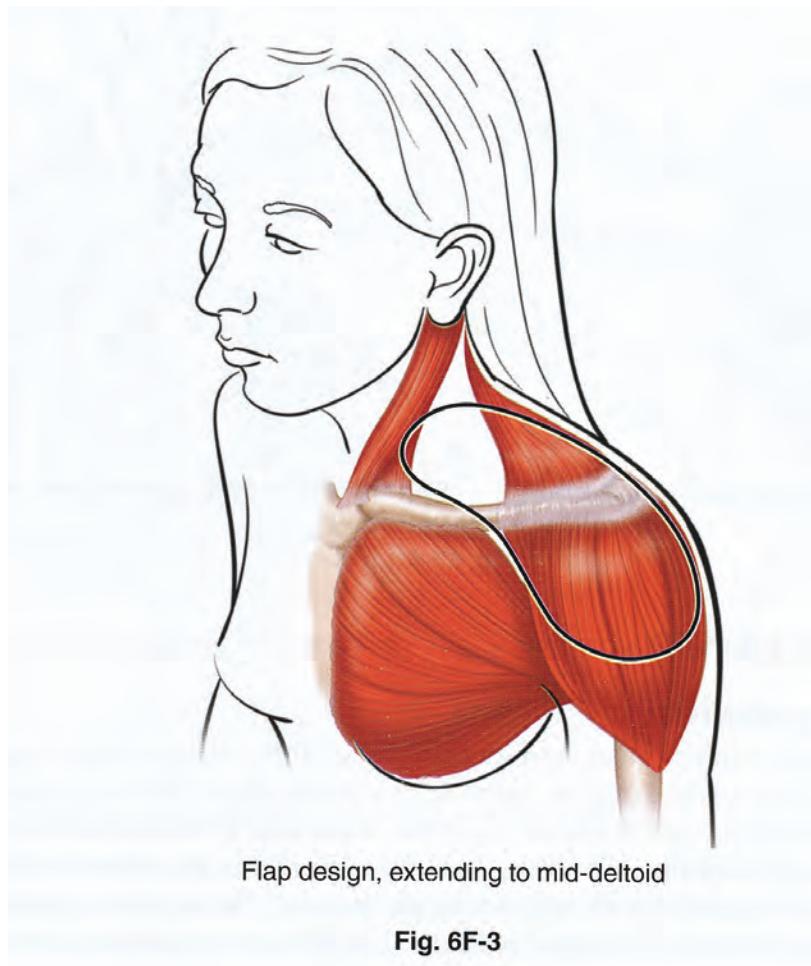


**Fig. 6A-3 A, Design for a standard flap. B, A deltopectoral flap is possible with delay**

## **Flap: Supraclavicular (SCA) flap**

<b>Tissues available:</b>	skin, fascia
<b>Vascular Anatomy:</b>	supraclavicular artery(1.0-1.5mm) and vein(1.0-1.5mm) Branch of the thyrocervical trunk
<b>Innervation:</b>	cervical nerves (C2-C4)
<b>Flap Dimensions:</b>	primary closure with widths up to 7 cm; can extend to mid-deltoid without delay
<b>Advantages:</b>	acceptable donor morbidity, especially if donor closed; tissues are thin and pliable and have a good color match for the face
<b>Disadvantages:</b>	skin graft of donor unsightly
<b>Things to note:</b>	easy to dissect; care should be taken when passed through a subcutaneous tunnel. Allow for post-op swelling and avoid pedicle compression

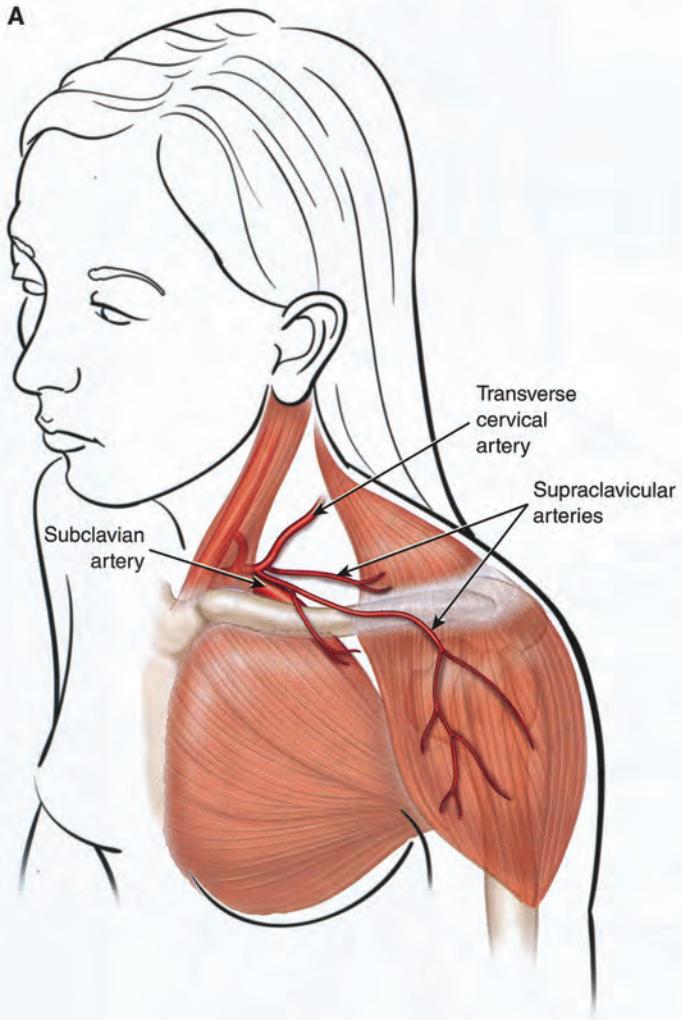
**Notes:**



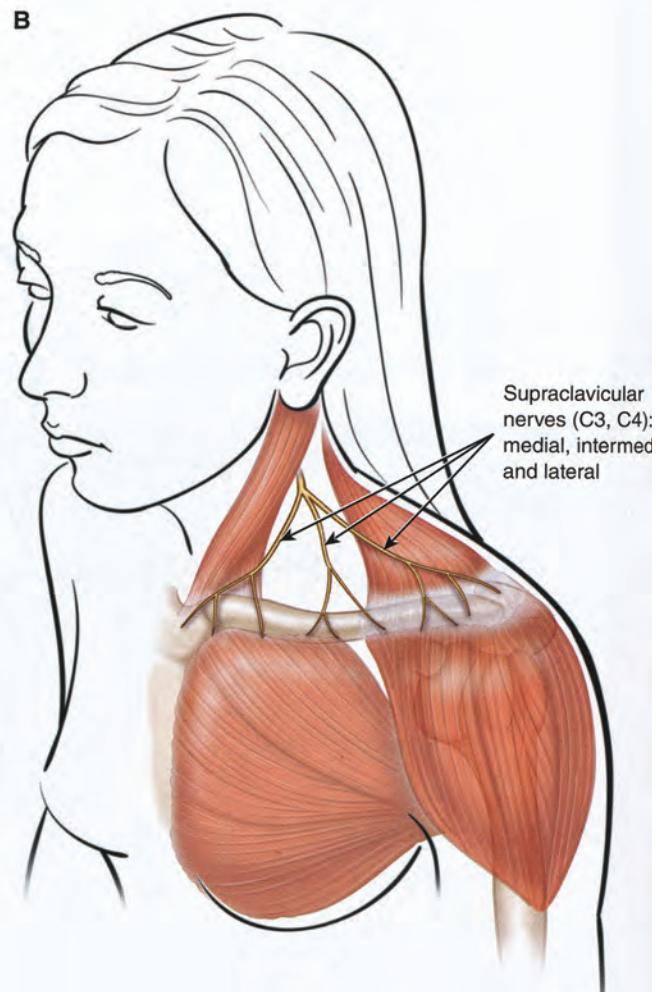
**Fig. 6F-3**

ANATOMY OF THE SUPRACLAVICULAR ARTERY FLAP

A



B



## **Flap: Forehead Flap**

**Tissues available:** skin

**Vascular Anatomy:** supratrochlear vessels

**Innervation:** supraorbital and supratrochlear nerves

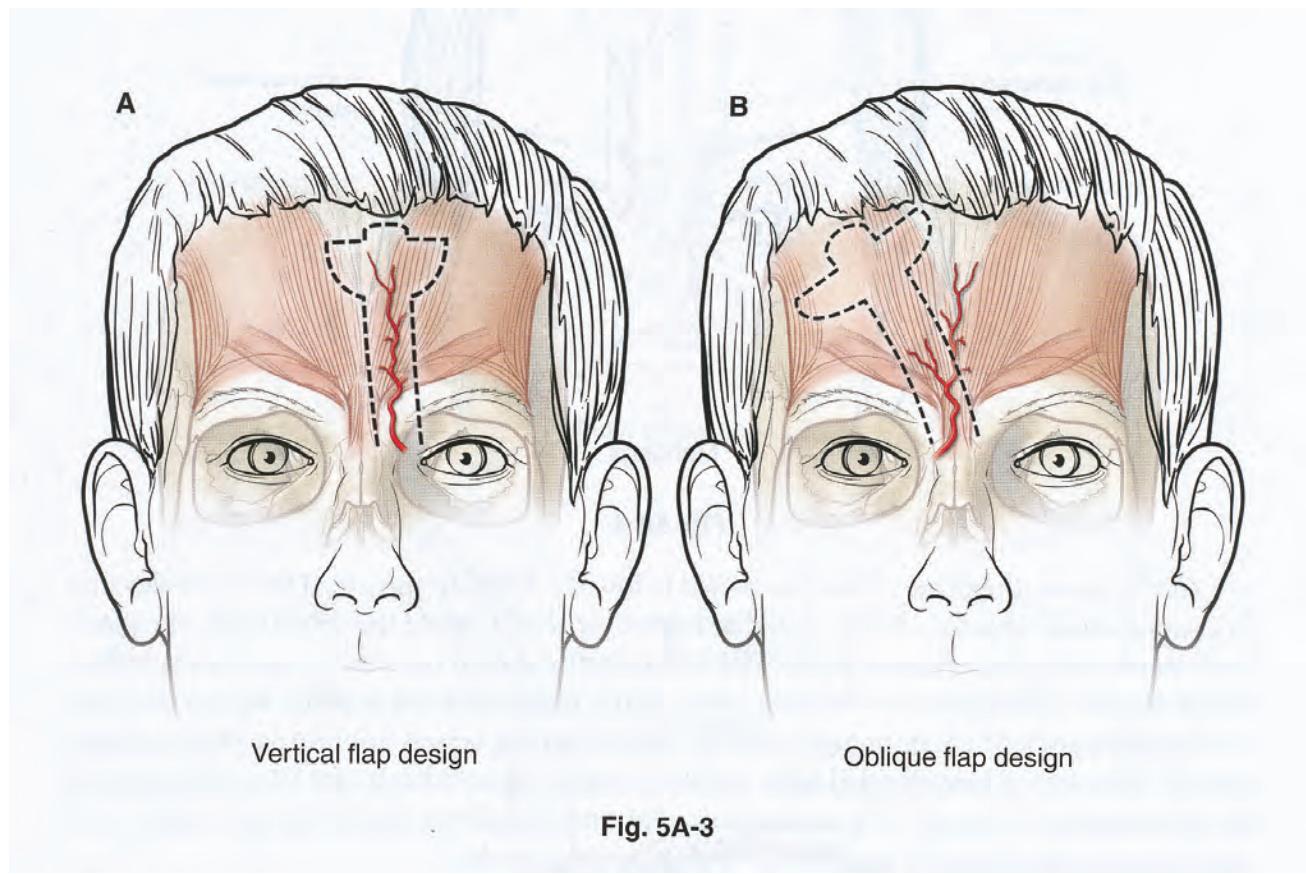
**Flap Dimensions:** 5x13 cm

**Advantages:** excellent color and texture match on the face

**Disadvantages:** anterior scalp anesthesia; often requires secondary division and inset

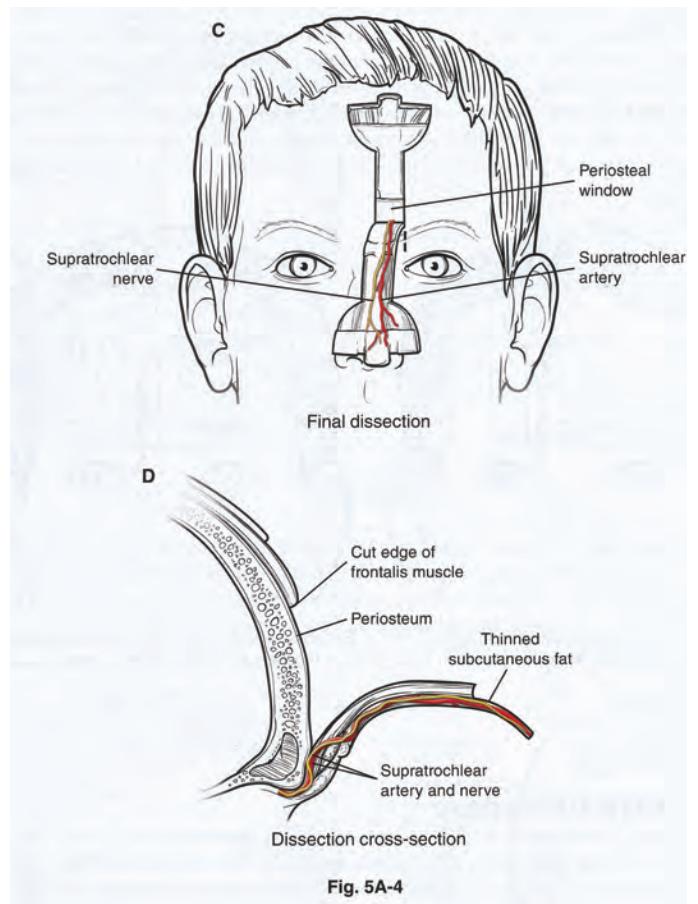
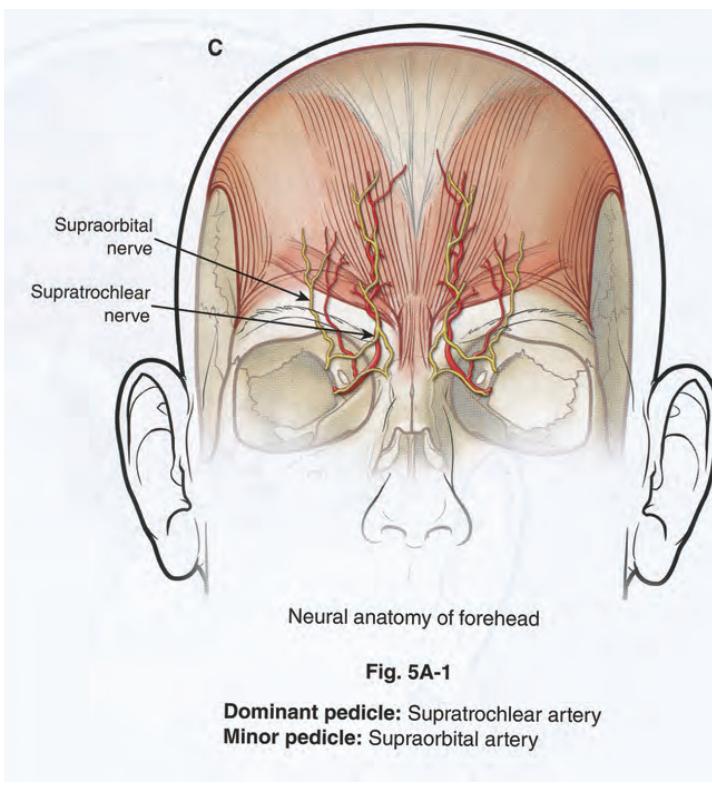
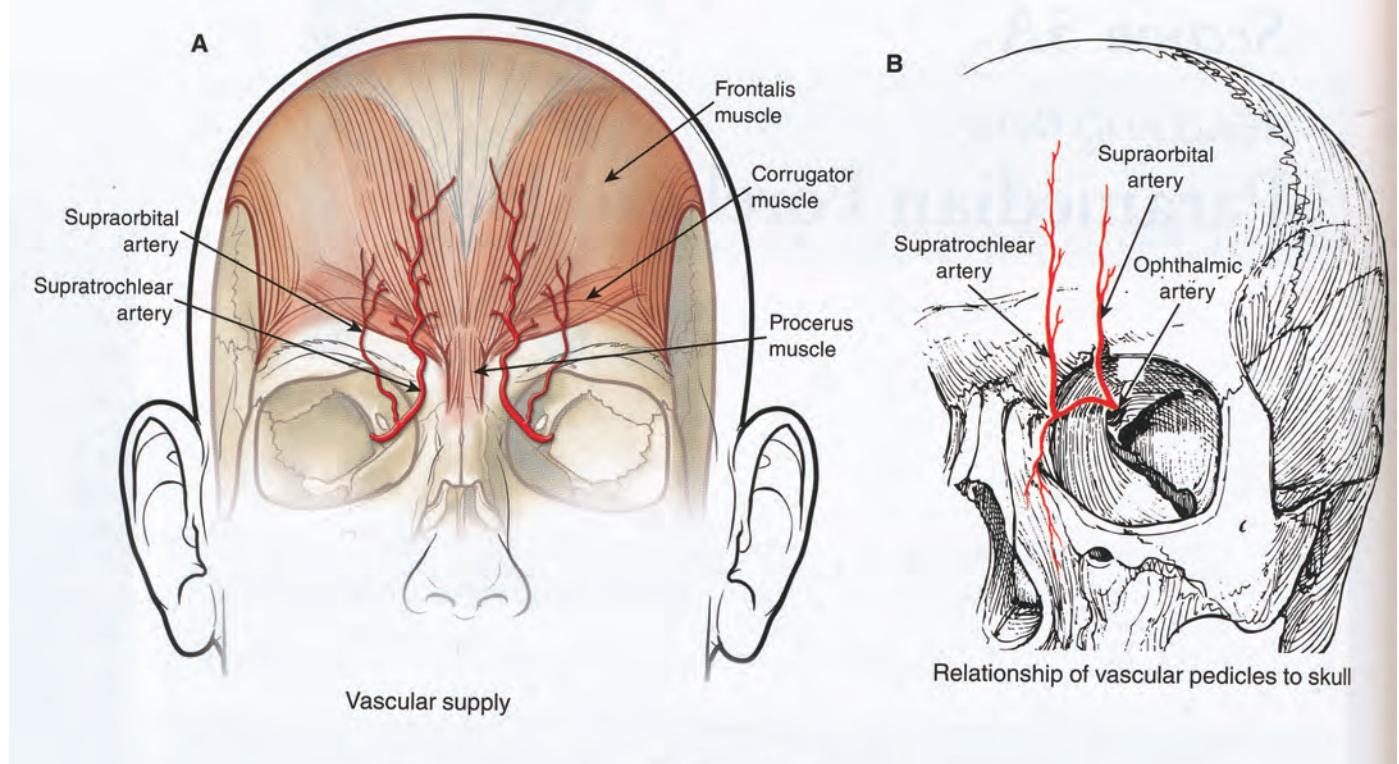
**Things to note:** consider prior tissue expansion of surrounding forehead for larger defects;

**Notes:**



**Fig. 5A-3**

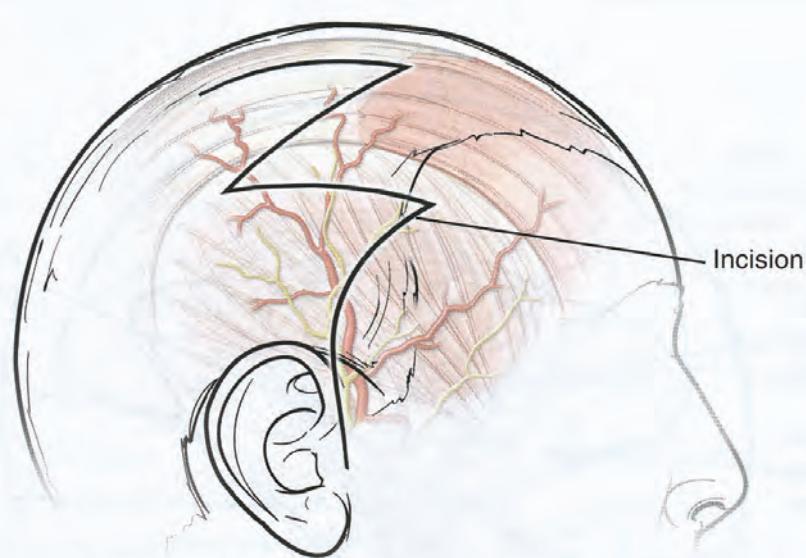
## ANATOMY OF THE PARAMEDIAN FOREHEAD FLAP



## **Flap: Temporal Parietal Fascial Flap (TPFF)**

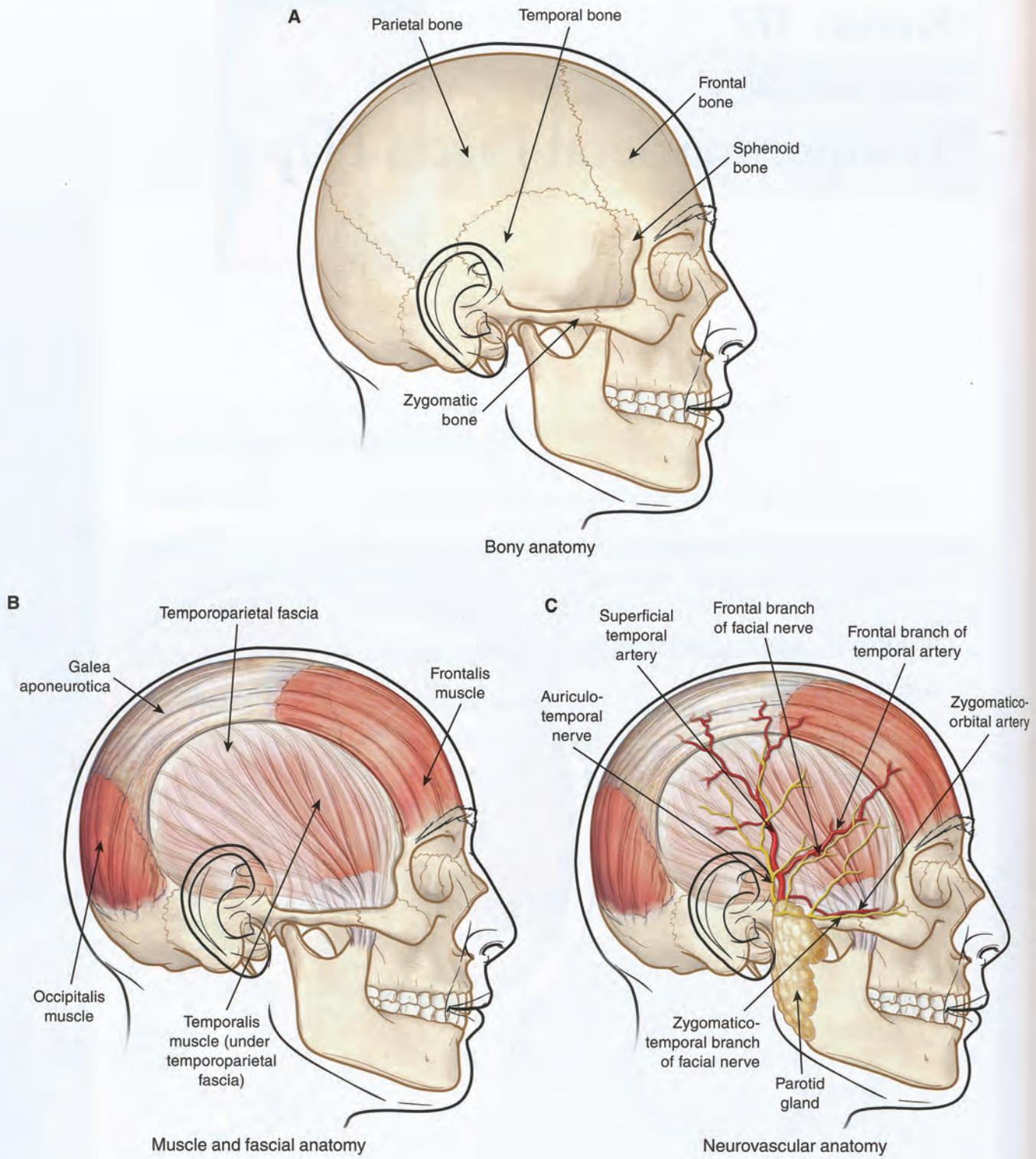
<b>Tissues available:</b>	fascia
<b>Vascular Anatomy:</b>	superficial temporal artery(1.5-2.7mm) and superficial temporal vein(2-3.2mm)
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	8x15 cm
<b>Advantages:</b>	well hidden donor scar; allows 2 team reconstruction
<b>Disadvantages:</b>	scar alopecia; short pedicle (2-4 cm); possible frontal nerve injury
<b>Things to note:</b>	can have 2 paddles of tissue (deep and superficial fascial layers) useful in providing a gliding surface or wrapping grafts and prostheses

**Notes:**



**Fig. 5D-3** Once the superficial temporal artery's course is determined by handheld Doppler, a zig-zag incision is planned in the hair-bearing area to expose the flap and give the best cosmesis.

### ANATOMY OF THE TEMPOROPARIETAL FASCIA FLAP

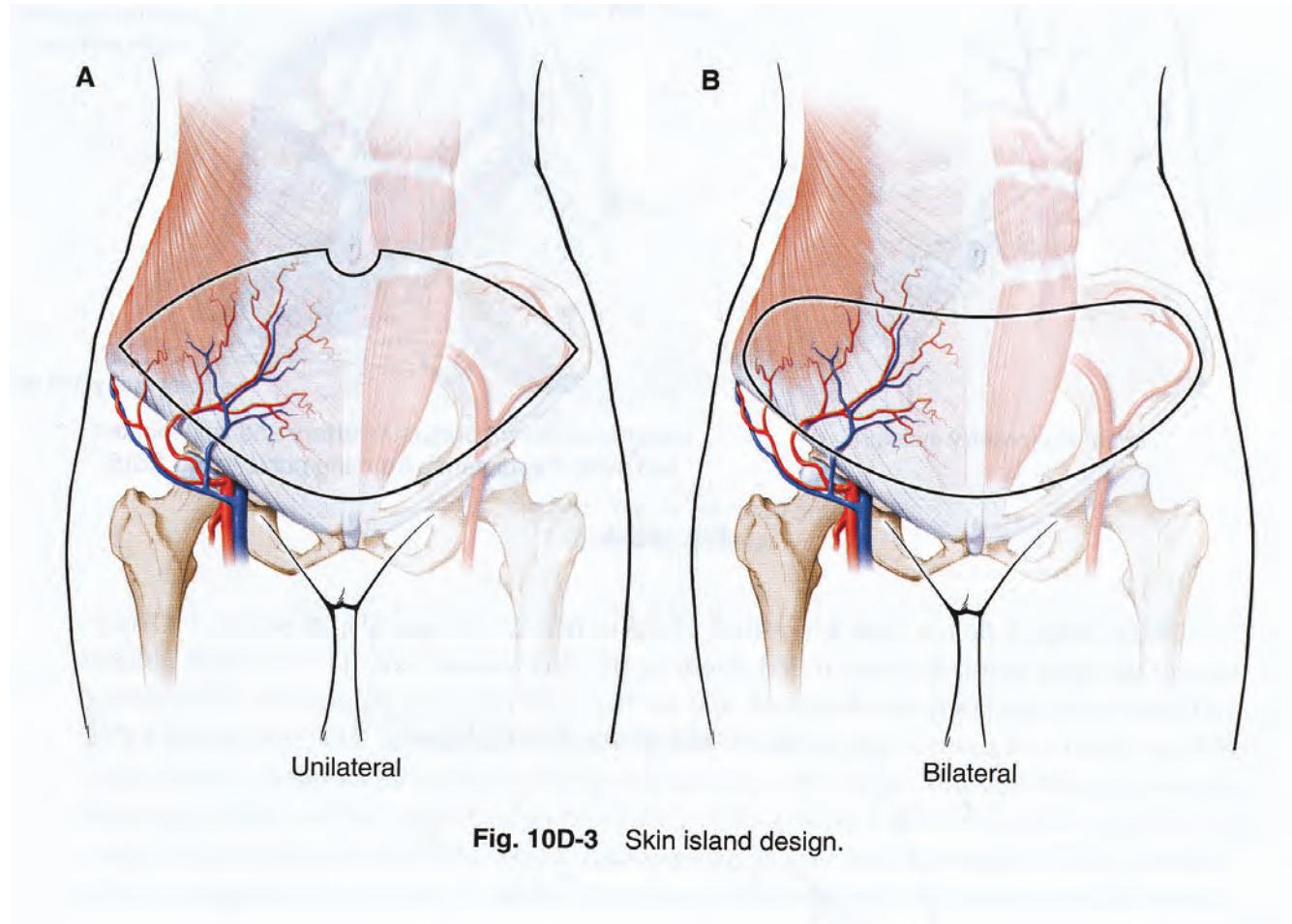


**Fig. 5D-1**  
Dominant pedicle: Superficial temporal artery

## Flap: Superficial Inferior Epigastric Artery (SIEA) Flap

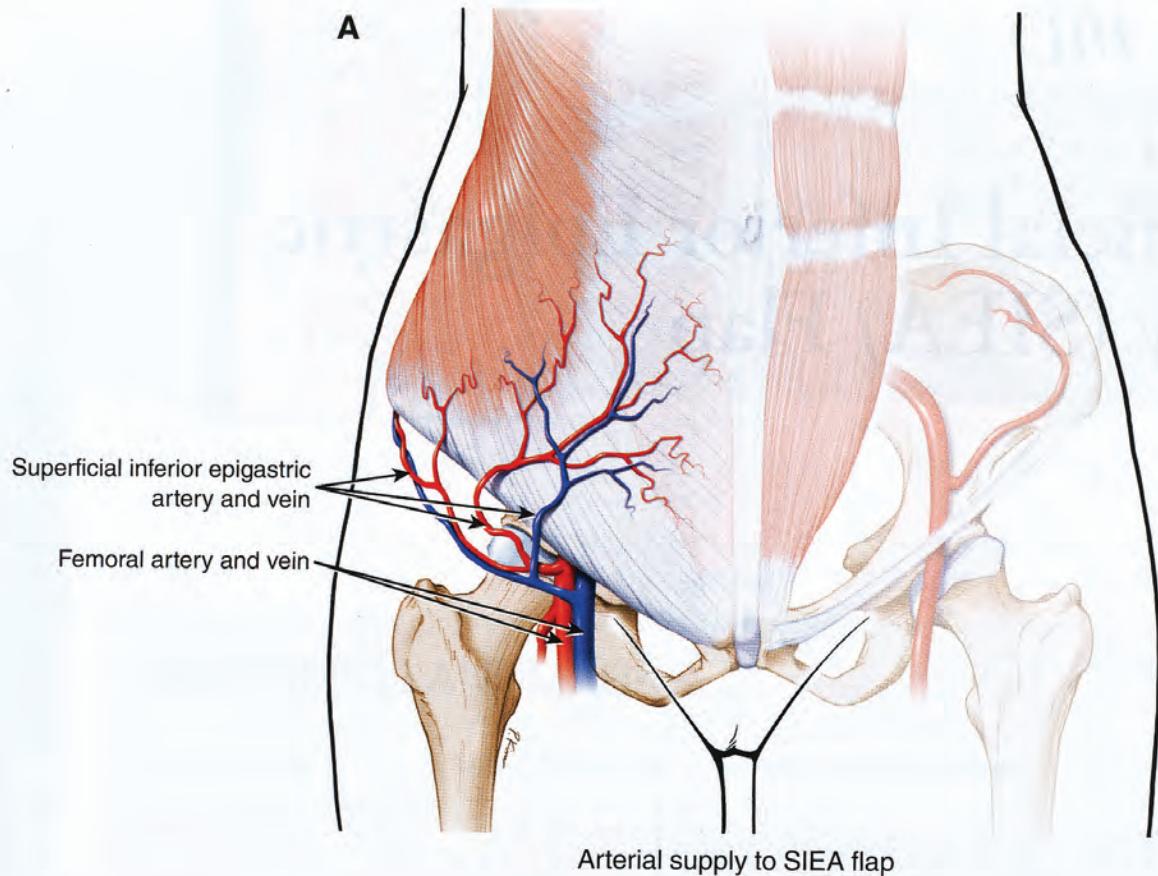
<b>Tissues available:</b>	cutaneous
<b>Vascular Anatomy:</b>	superficial inferior epigastric artery
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	15 x 20 cm
<b>Advantages:</b>	no muscle sacrifice or fascial incision required, acceptable donor site scar, ample available tissue
<b>Disadvantages:</b>	technically demanding, anatomic variations, seldom present greater than 1.5mm in diameter, limiting its use
<b>Things to note:</b>	poor perfusion across midline; may have added blood supply via SCIA (see groin flap) or adding a DIEP pedicle

Notes:



**Fig. 10D-3** Skin island design.

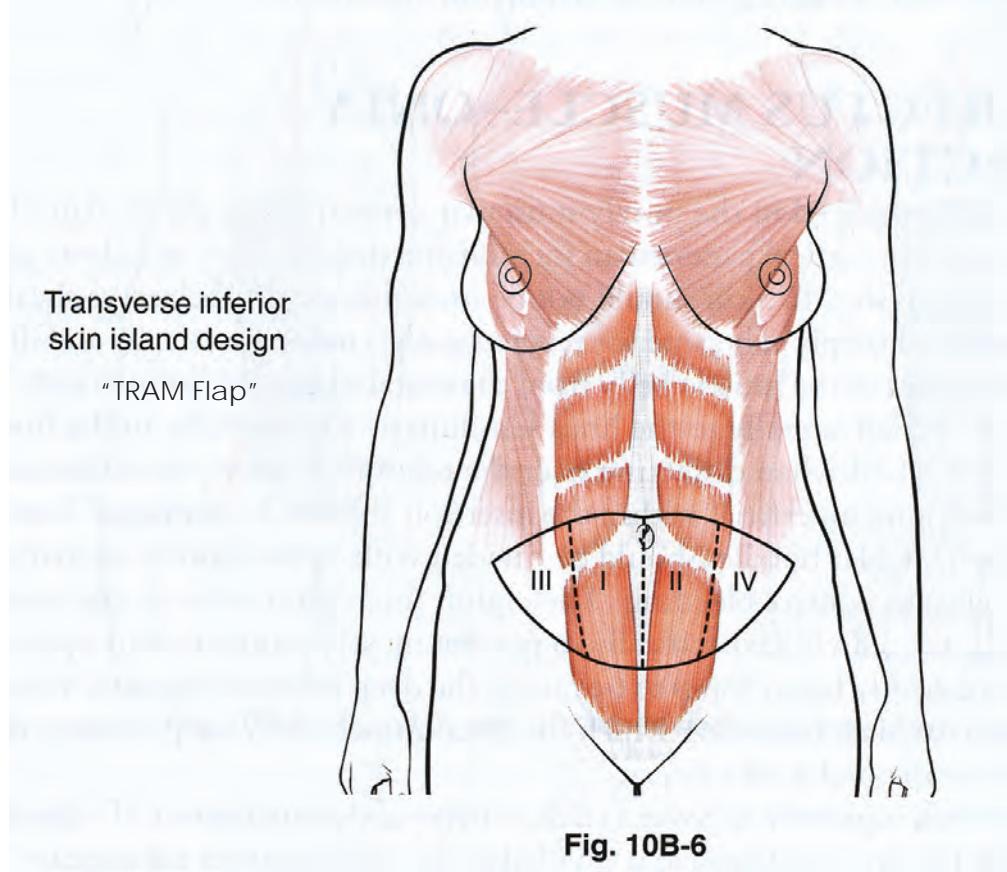
### ANATOMY OF THE SUPERFICIAL INFERIOR EPIGASTRIC ARTERY (SIEA) FLAP



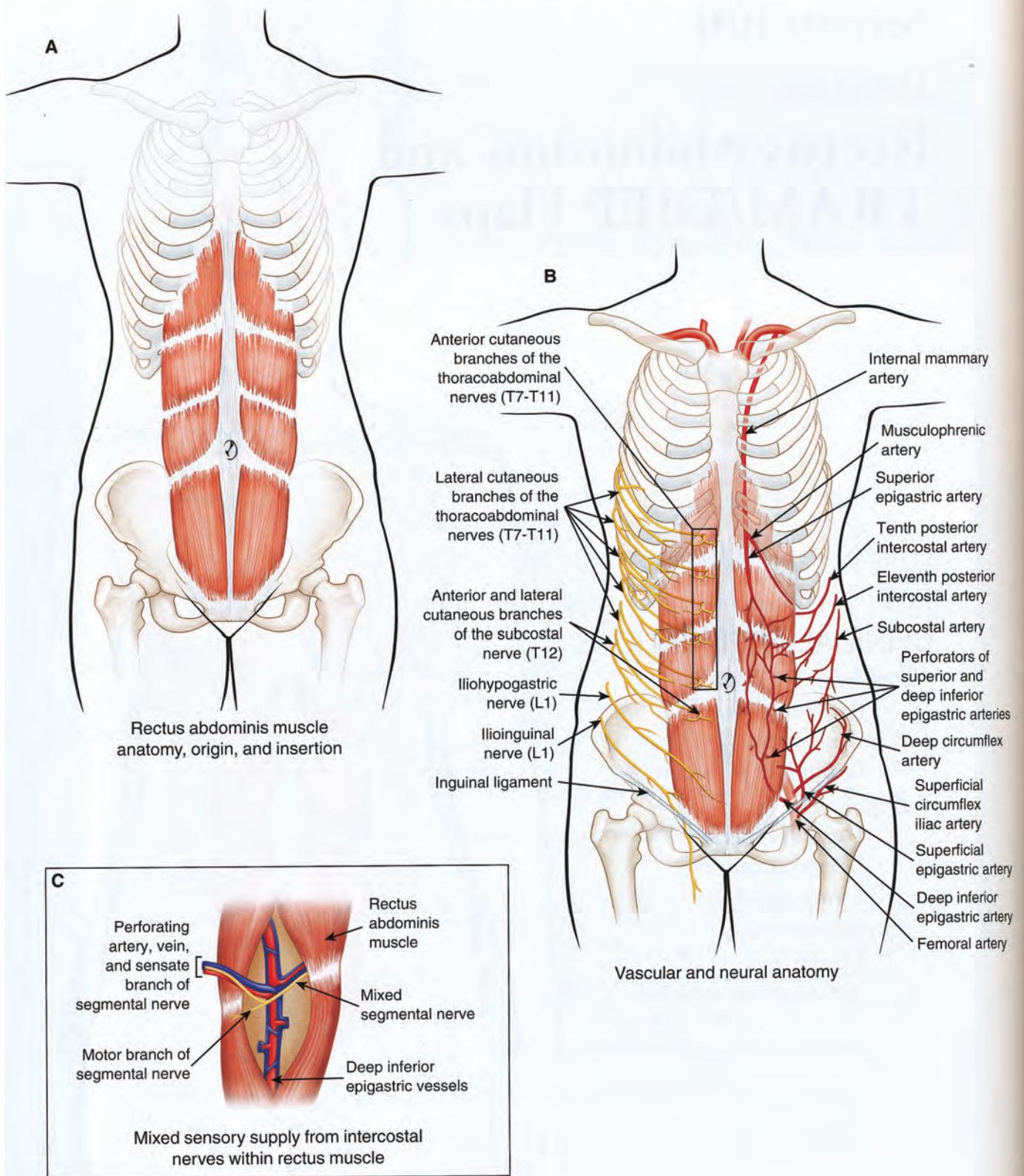
## **Flap: Rectus Abdominis Flap / DIEP / TRAM**

<b>Tissues available:</b>	muscle, skin, peritoneum
<b>Vascular Anatomy:</b>	superior epigastric artery(1.6mm) and vein(2.3mm); deep inferior epigastric artery(3.5mm) and vein(4mm), pedicle 7.5cm
<b>Innervation:</b>	segmental intercostal nerves (T7 to T12)
<b>Flap Dimensions:</b>	20x35cm
<b>Advantages:</b>	expendable large muscle with large associated skin paddles; long vascular pedicle; 2 team approach possible
<b>Disadvantages:</b>	abdominal wall weakness and hernias possible; skin paddle viability best over the muscle perforators; bulges can be associated with rotation flaps at the rotation point
<b>Things to note:</b>	skin flap orientation may be vertical (VRAM) or horizontal (TRAM) anywhere over the muscle; skin harvested without muscle, just perforators (DIEP) possible; peritoneal/fascial flap described; supercharging flap possible through non-dominant pedicle (SIEA/V, DIEA/V, or DSEA/V) depending on flap design

### Notes:

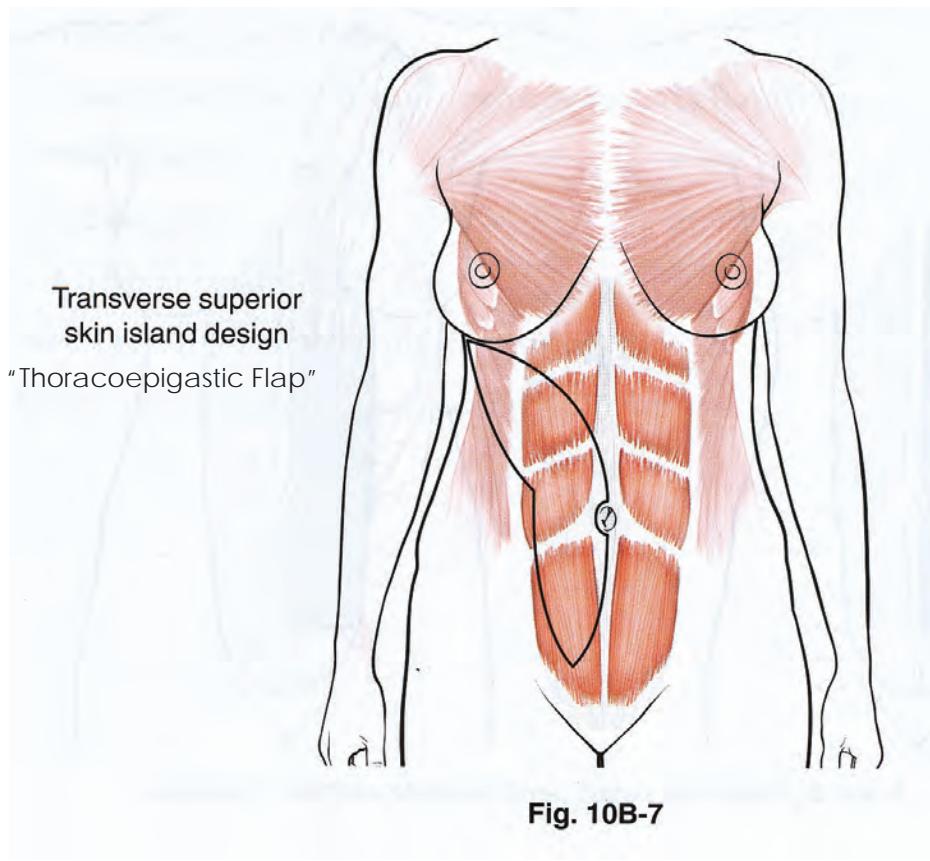
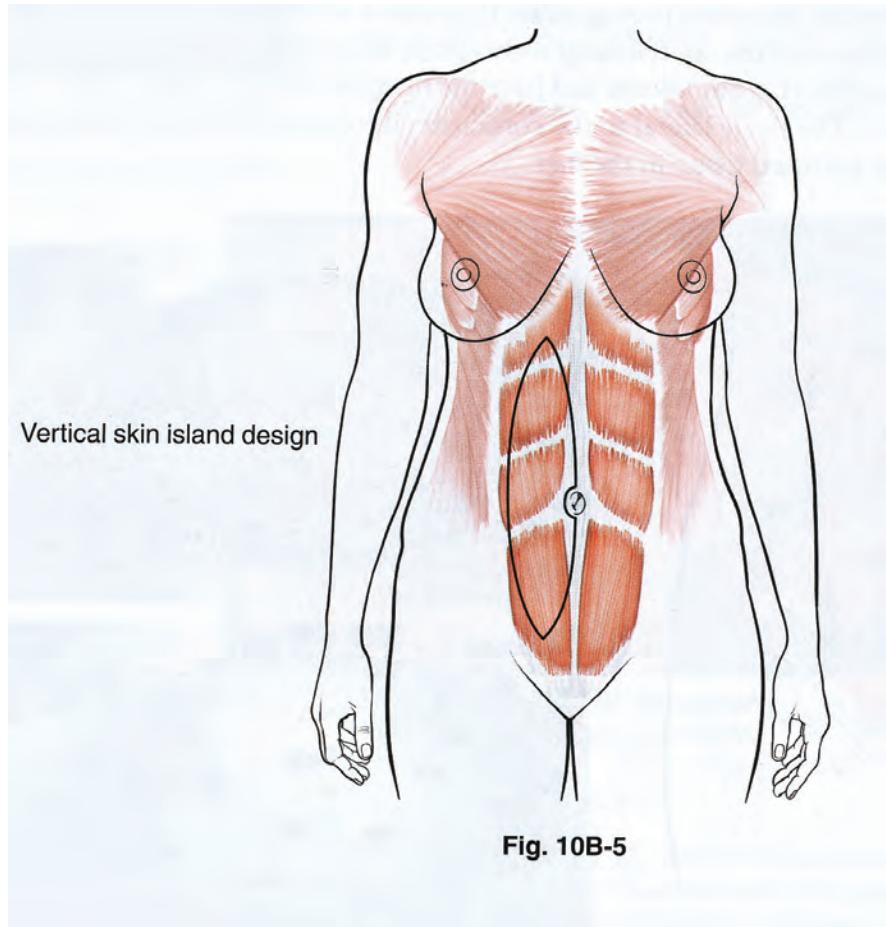


## ANATOMY OF THE RECTUS ABDOMINIS AND TRAM/DIEP FLAPS



**Fig. 10B-1**

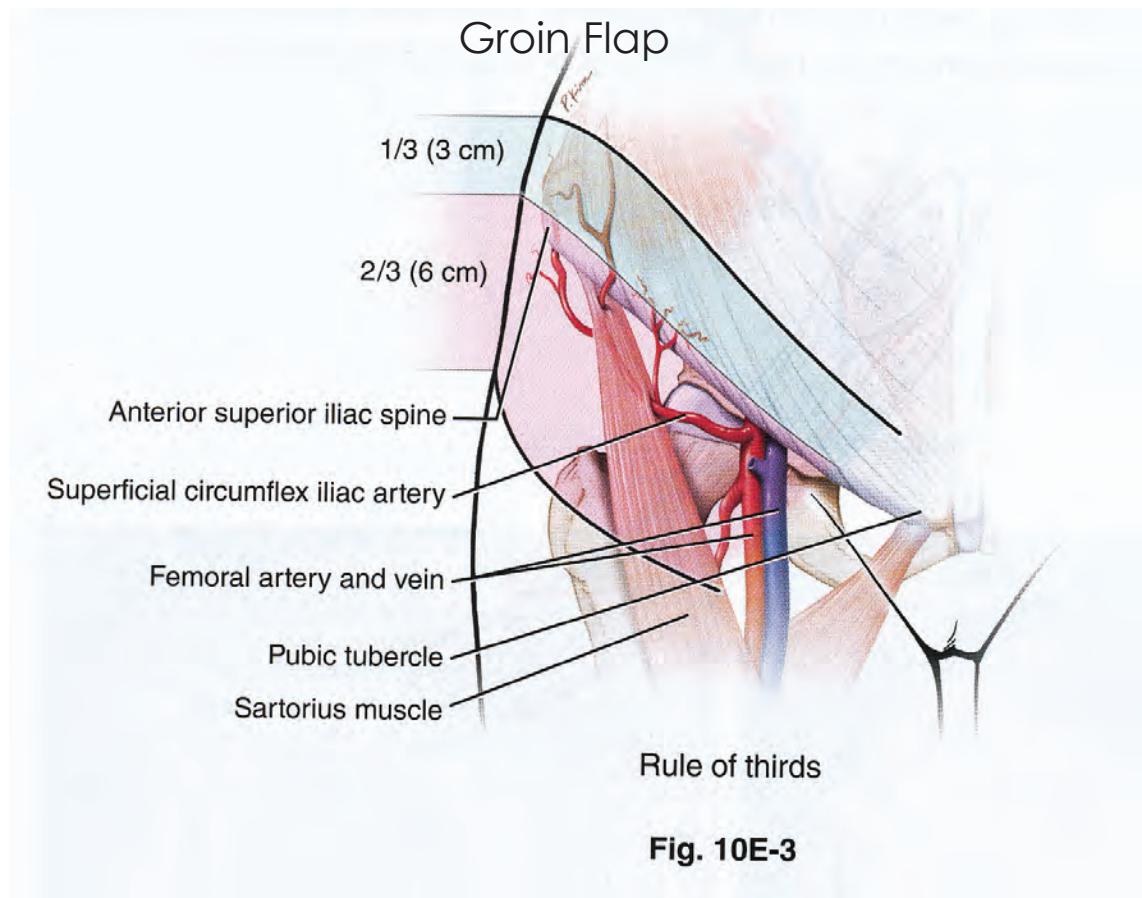
**Dominant pedicles:** Superior epigastric artery; deep inferior epigastric artery



## Flap: Groin Flap / SCIP

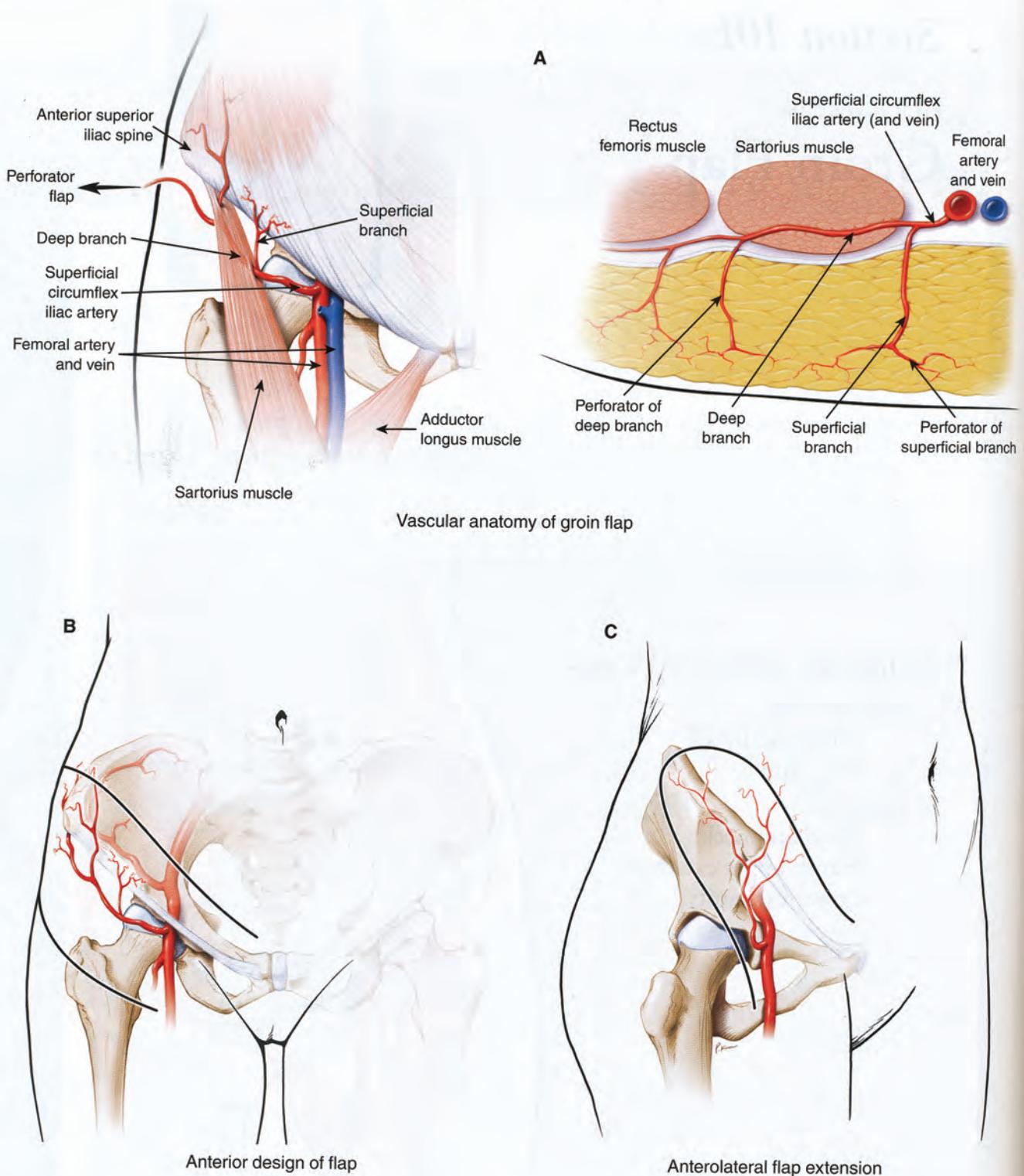
<b>Tissues available:</b>	skin
<b>Vascular Anatomy:</b>	superficial circumflex iliac artery (0.8-1.8mm) and vena comitantes (0.8-1mm); also a superficial vein (2-3mm) which joins the SIEV; pedicle length is 2.5-4cm
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	10x25cm
<b>Advantages:</b>	acceptable donor scar location; large flap with primary closure of donor; supine harvest; hairless
<b>Disadvantages:</b>	unreliable anatomy, short pedicle (2-4 cm) with small artery; possible lateral cutaneous nerve distribution anesthesia
<b>Things to note:</b>	identify and ascertain suitability of pedicle prior to flap harvest; pedicled groin flap is often a backup to complication or loss of free tissue transfer to hand; Possible chimeric flap with superficial inferior epigastric flap (common vascular trunk); can increase flap size with delay procedures

**Notes:**



**Fig. 10E-3**

### ANATOMY OF THE GROIN FLAP



**Fig. 10E-1**  
**Dominant pedicle:** Superficial circumflex iliac artery

## Flap: Pudendal Thigh (Singapore) Flap

**Tissues available:** fasciocutaneous

**Vascular Anatomy:** posterior labial artery off the perineal artery

**Innervation:** posterior labial branch of the pudendal nerve

**Flap Dimensions:** 6 x 15 cm

**Advantages:** acceptable donor scar; sensate; thin and pliable;

**Disadvantages:** may be in irradiated field

**Things to note:** subcutaneous dissection at the base aids rotation of flap; bilateral flaps can be used for total vaginal reconstruction

**Notes:**

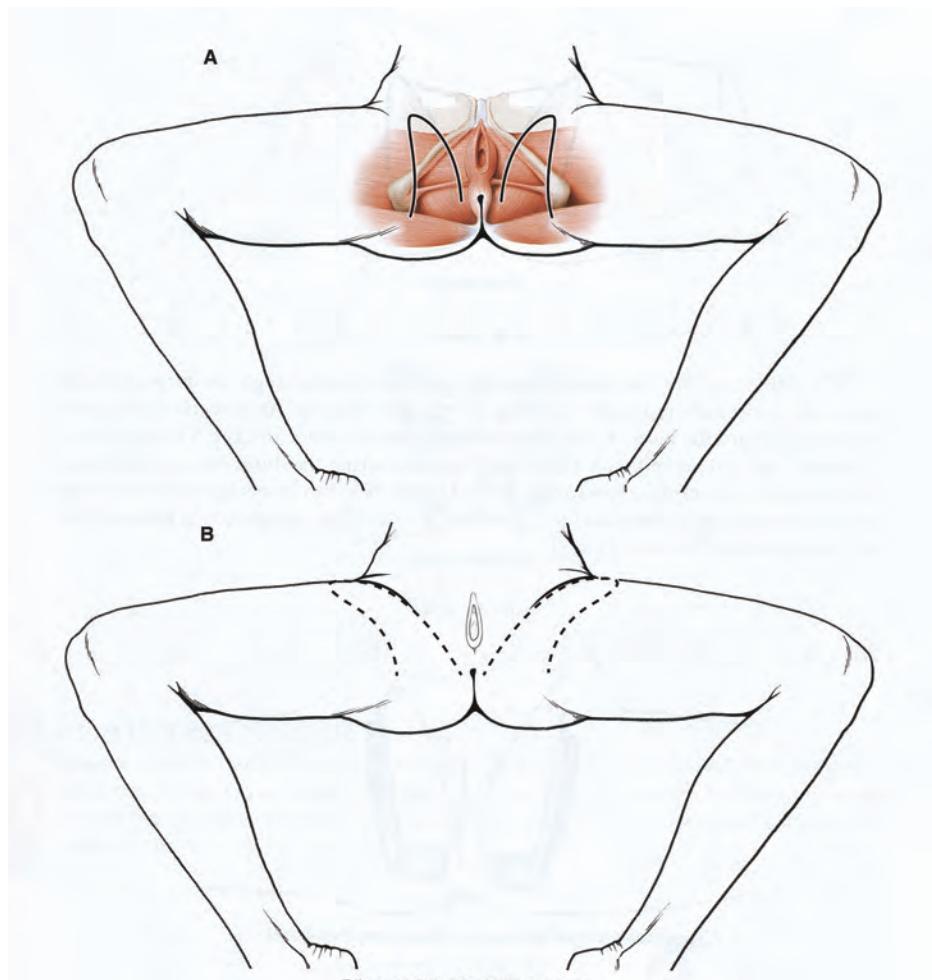
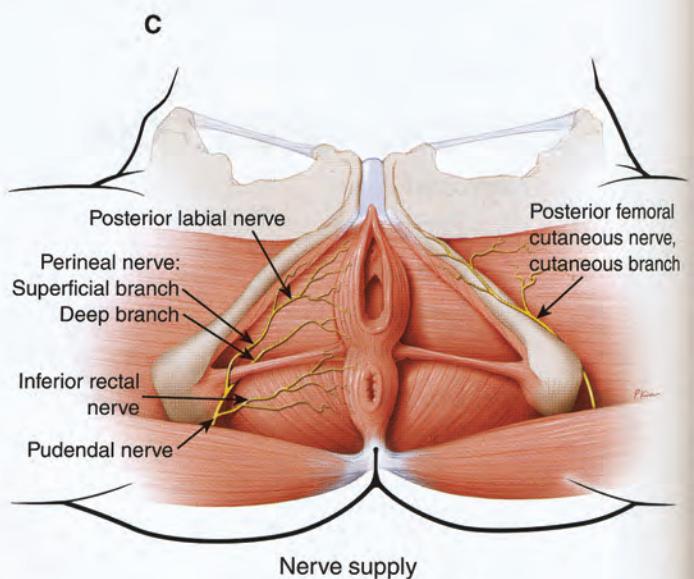
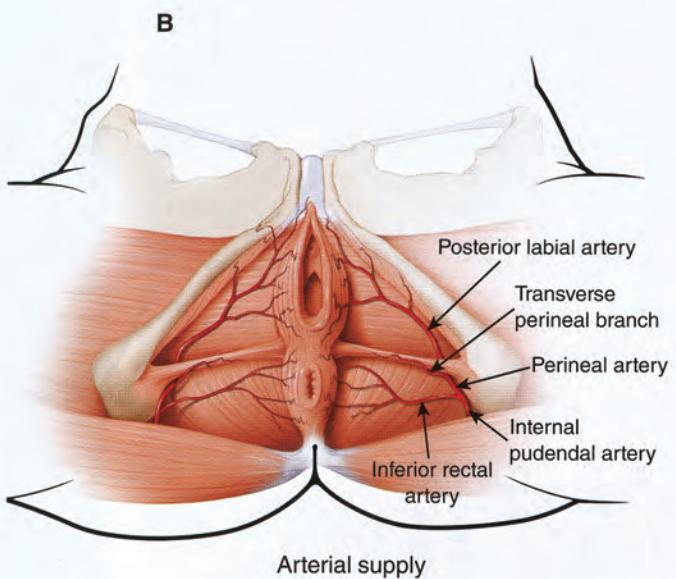
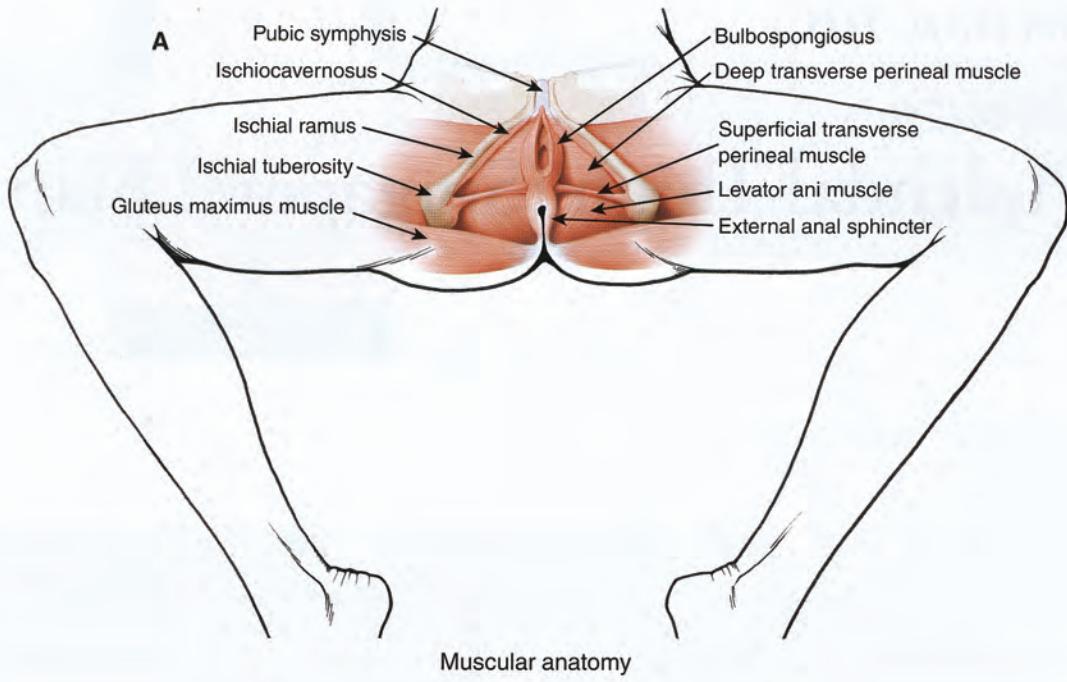


Fig. 10G-3

### ANATOMY OF THE PUDENDAL-THIGH (SINGAPORE) FLAP



**Fig. 10G-1**

**Dominant pedicle:** Posterior labial artery

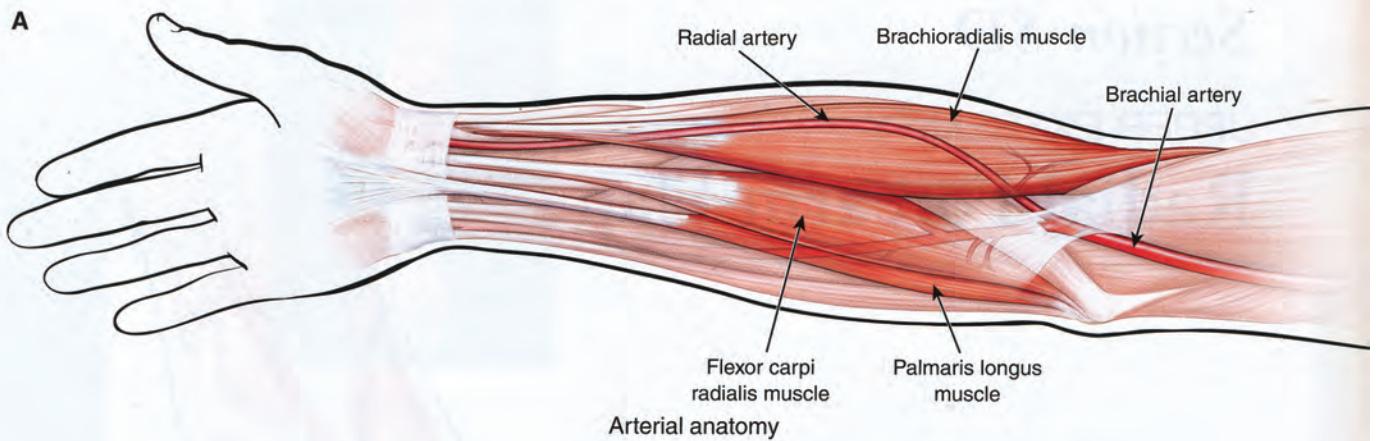
## **Flap: Radial Forearm Flap**

<b>Tissues available:</b>	skin, adipofascial, muscle, bone
<b>Vascular Anatomy:</b>	radial artery(3-4mm), radial vena comitantes (3-5mm), cephalic vein
<b>Innervation:</b>	lateral antebrachial cutaneous nerve
<b>Flap Dimensions:</b>	8 x 20 cm
<b>Advantages:</b>	peripheral location allows 2 team approach; long pedicle; thin, pliable tissues; can include 1/3 of radius or brachioradialis muscle
<b>Disadvantages:</b>	conspicuous donor site skin graft; sacrifice radial artery; radius fracture when bone harvested (15%)
<b>Things to note:</b>	Allen's test; can use as "flow through" flap; many shapes, multiple islands possible; reverse island flap based distally possible

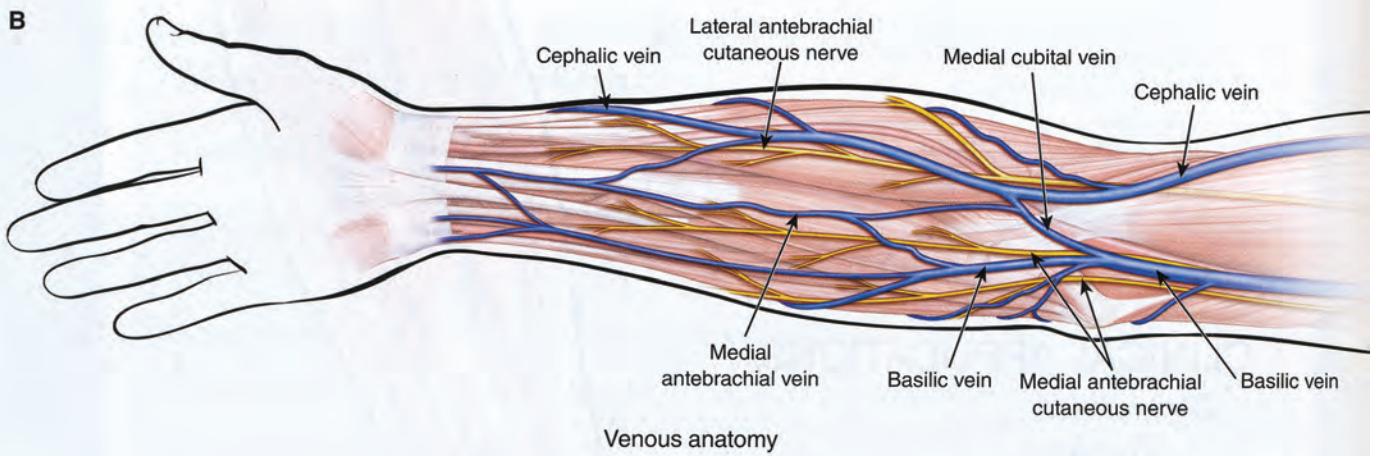
**Notes:**

### ANATOMY OF THE RADIAL FOREARM FLAP

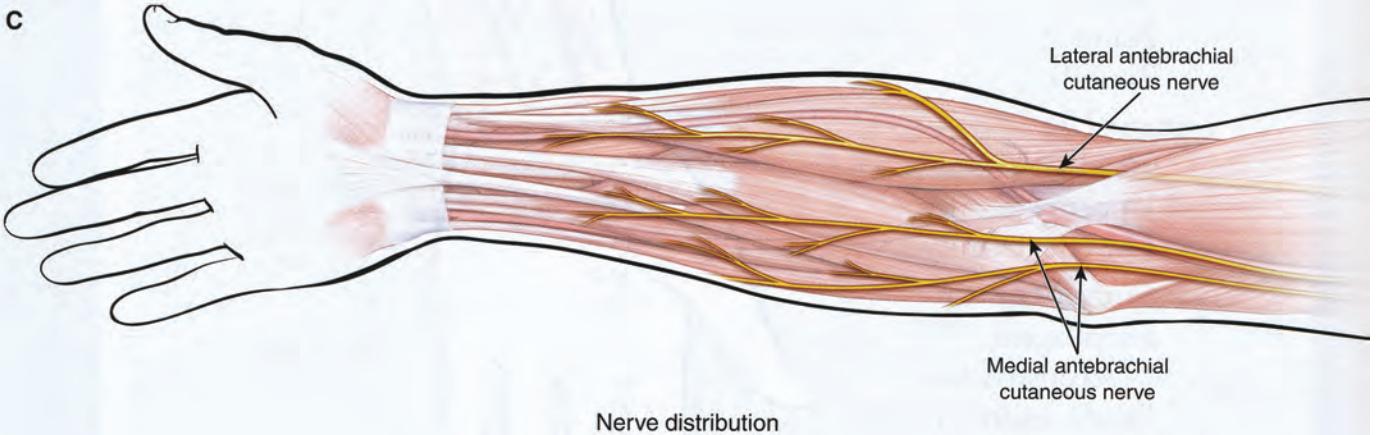
**A**



**B**

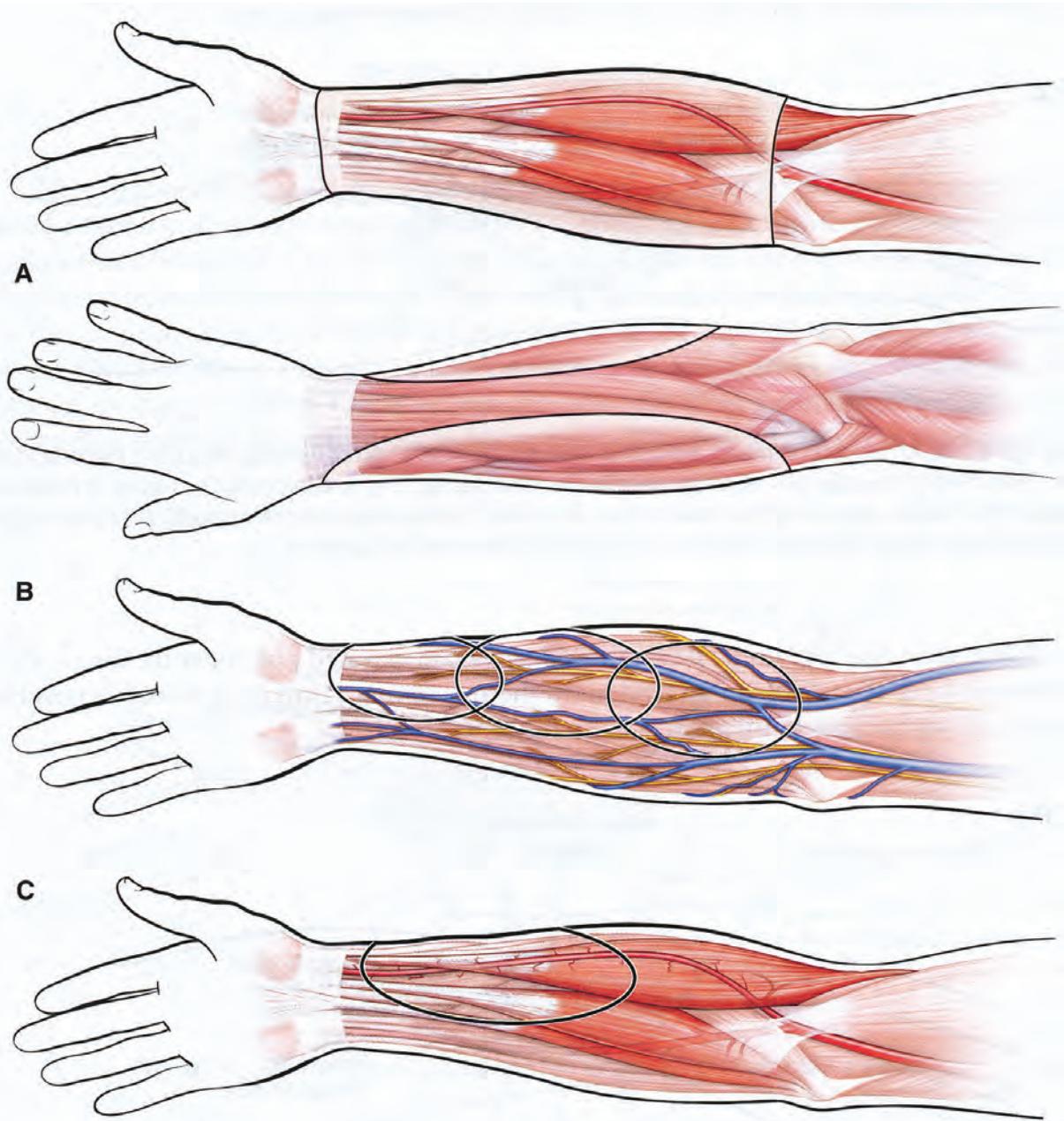


**C**



**Fig. 8D-1**

**Dominant pedicle: Radial artery**



**Fig. 8D-3** **A**, The territory of this flap extends from below the antecubital crease proximally to the wrist flexion crease distally. The distal width is from the extensor hallucis longus tendon radially to the extensor carpi ulnaris tendon ulnarly. The proximal width is from the lateral to medial humeral epicondyles. **B**, A fasciocutaneous flap can be designed and placed proximally, centrally, or more distally on the forearm. Middle positioning is useful if the recipient pedicle is of suitable length and improves aesthetics by avoiding the wrist crease. Most perforators are in the distal half of the forearm. Proximal positioning is useful when designing a reverse-flow flap. **C**, An average flap measures 5 to 8 cm wide and 8 to 10 cm long. The flap is designed so that the lateral third of the flap is located lateral to the course of the radial artery.

## **Flap: 1) Flexor carpi ulnaris (FCU) and 2) ulnar flap**

**Tissues available:** 1) muscle and 2) skin / muscle and skin / muscle bone and skin

---

**Vascular Anatomy:** 1) FCU: This is a type 2 muscle flap. The dominant pedicle is the posterior ulnar recurrent artery. This vessel enters the muscle at the deep surface just distal to the elbow. The minor pedicle is the distal ulnar perforating branches.

**Vascular Anatomy:** 2) Ulnar flap: Proximal and distal branches of the ulnar artery with both superficial and deep venous drainage.

---

**Innervation:** 1) FCU: ulnar nerve

**Innervation:** 2) Ulnar flap: sensory via the medial antebrachial cutaneous nerve

---

**Flap Dimensions:** FCU: 20 X 5 cm and Ulnar flap: 8 X 12 cm

---

**Advantages:** 1. FCU: supine harvest on arm table. Ease of harvest.  
2. Ulnar flap: more aesthetic donor site than radial forearm flap

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**Disadvantages:** 1) FCU is powerful flexor of the wrist.  
2) color match is suboptimal for head and neck

---

**Notes:**

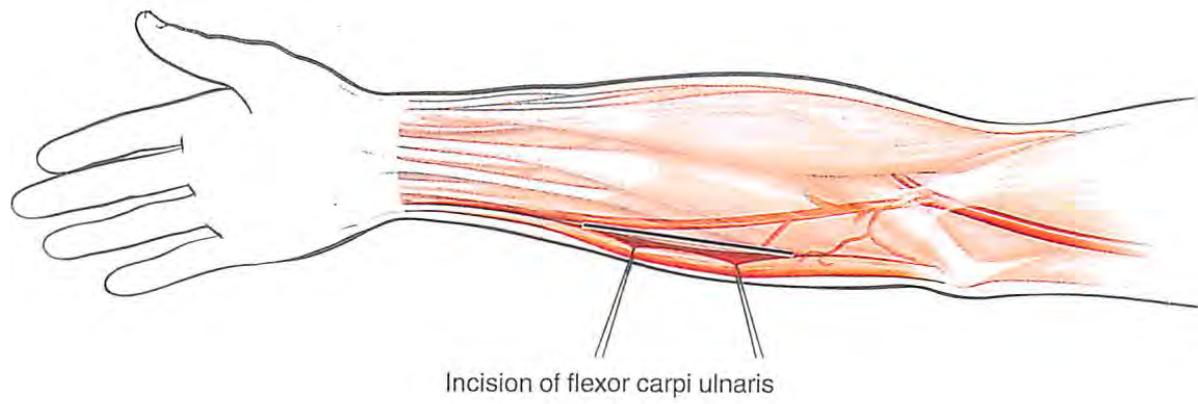


Fig. 8E-3

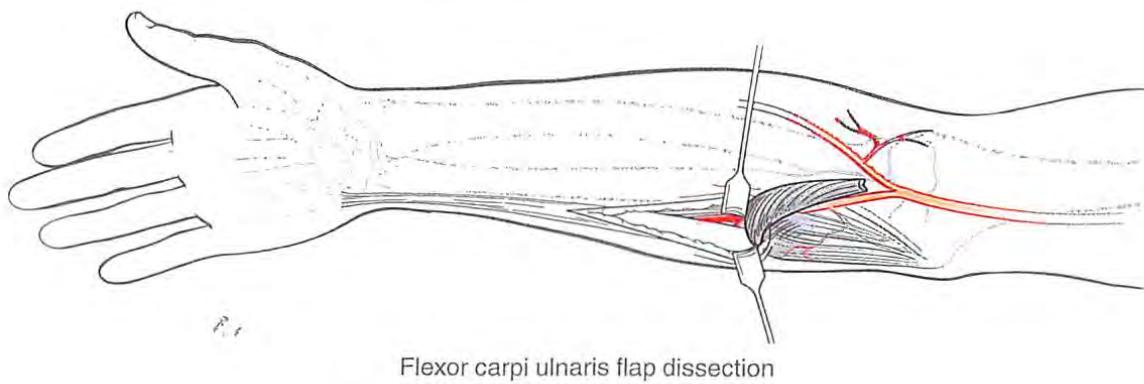
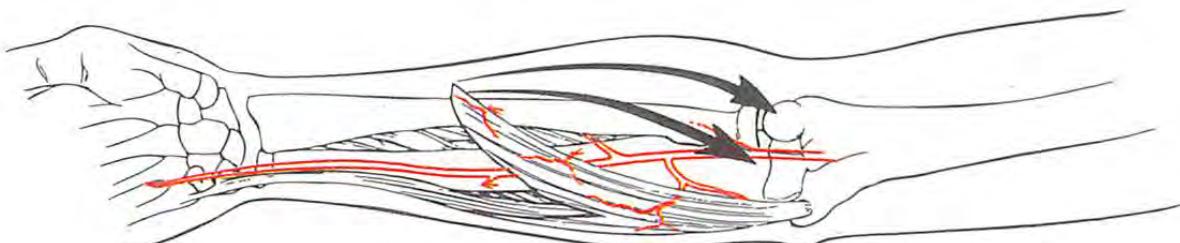
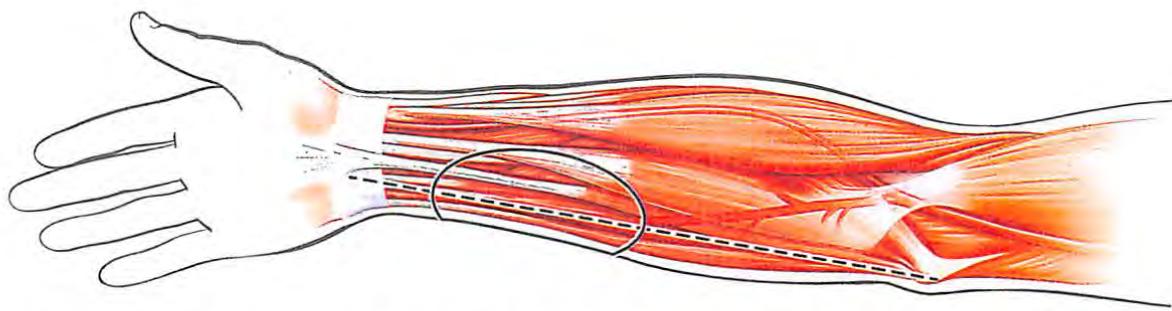


Fig. 8E-4

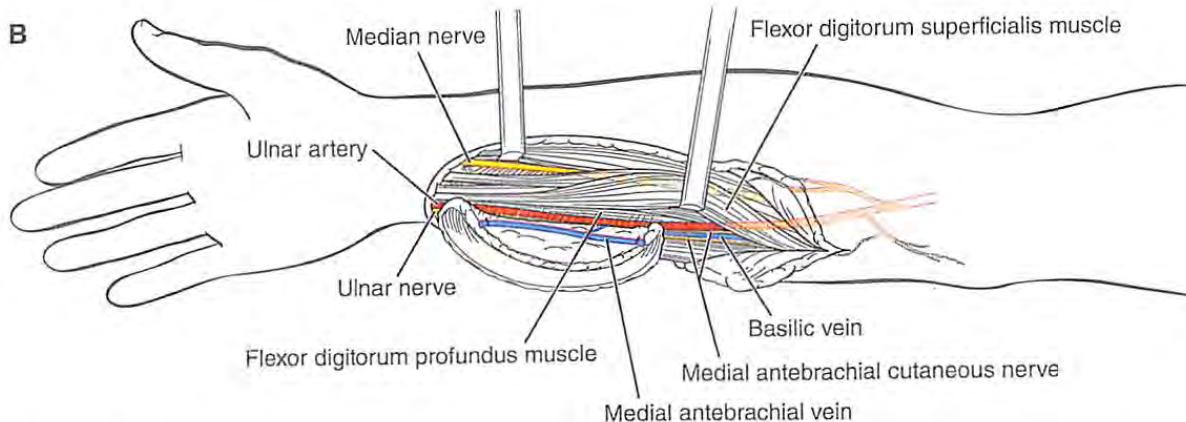


Arc to elbow and antecubital fossa

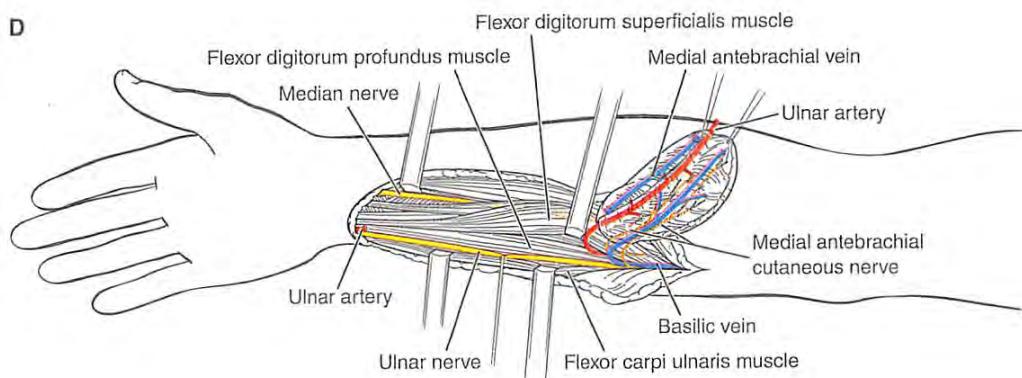
Fig. 8E-5



**Fig. 8F-3** The location of the ulnar artery distally is marked by the line connecting the medial epicondyle of the humerus and the pisiform bone. This is confirmed by Doppler ultrasonography. The flap design should have at least one third of the skin paddle radial to this line and should include the basilic vein.



**Fig. 8F-4 B**, The flap is further dissected to the intermuscular septum containing the perforators to the skin. The ulnar artery is divided distally, and any branches to surrounding muscles are also divided.



**Fig. 8F-4 D**, Dissection then proceeds from distal to proximal, extending the dissection of the pedicle proximally as needed for vessel diameter and length. The ulnar nerve is left within its bed, deep to the flexor carpi ulnaris.

## **Flap: Fibula Flap**

**Tissues available:** bone, skin, muscle

**Vascular Anatomy:** peroneal artery(1.5-2.5mm) and vein(2-4mm)

**Innervation:** motor branch to flexor hallucis muscle; no sensory nerve

**Flap Dimensions:** bone 26 cm; skin 8 x 15 cm

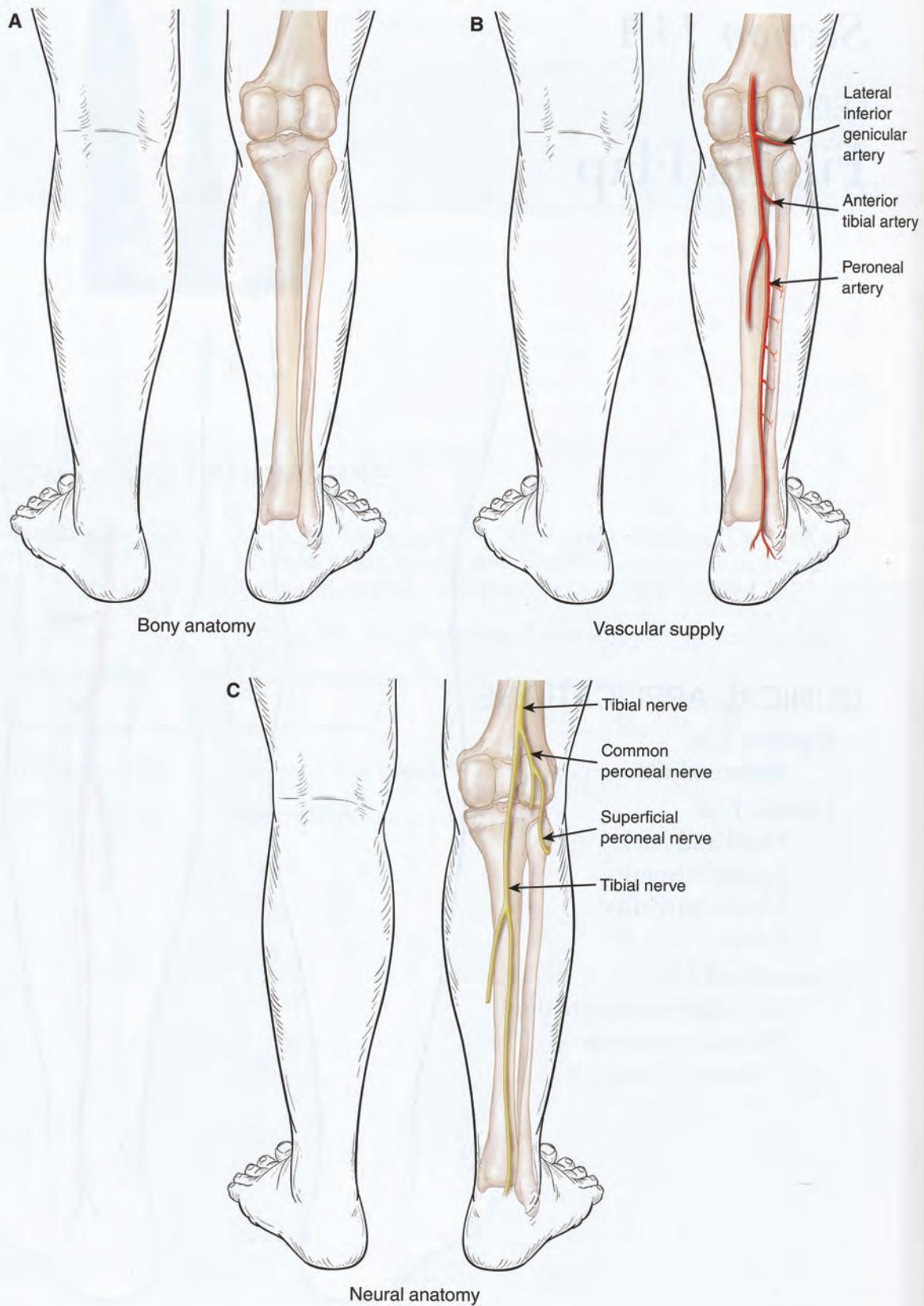
**Advantages:** acceptable donor morbidity (normal function, thin scar); 2 teams possible; segmental blood supply allows multiple osteotomies for shaping, maintaining vascularity to all segments

**Disadvantages:** larger donor sites require skin graft with poor cosmesis; tedious dissection

**Things to note:** can include flexor hallucis muscle and hemi-soleus muscle for additional bulk; Doppler skin perforators to incorporate in skin paddle; when in doubt regarding inflow to leg, get arteriogram

**Notes:**

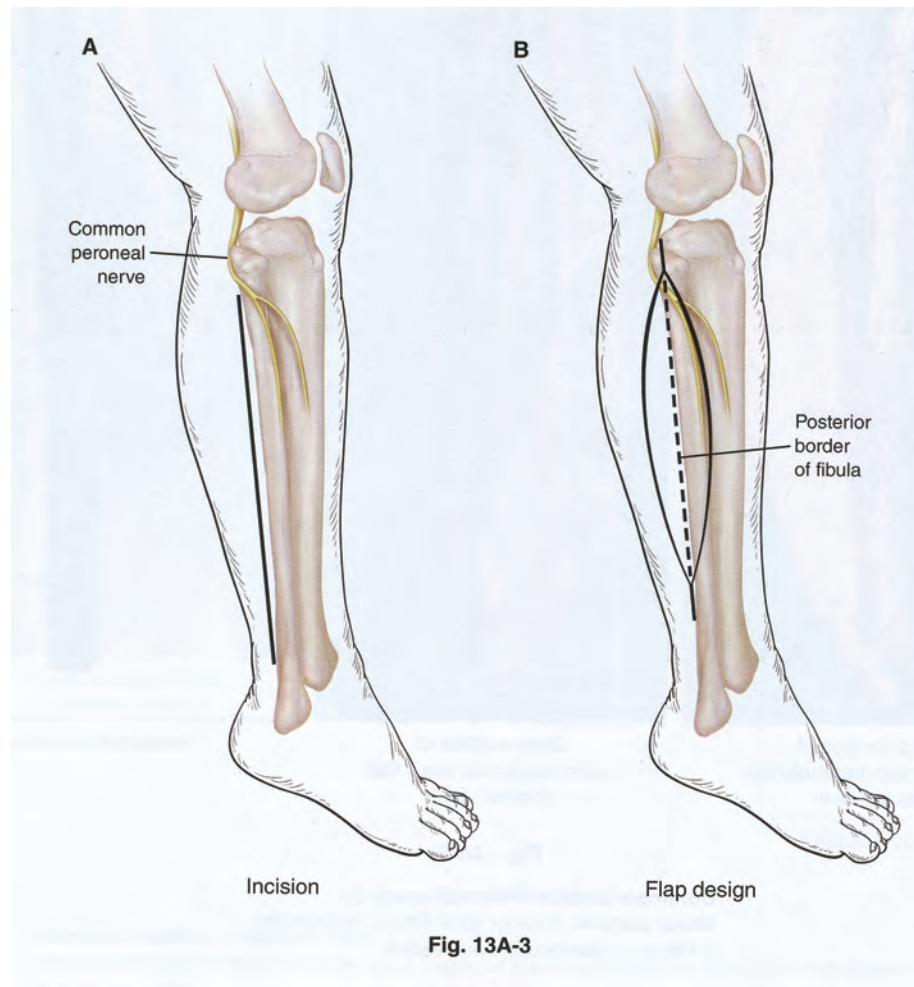
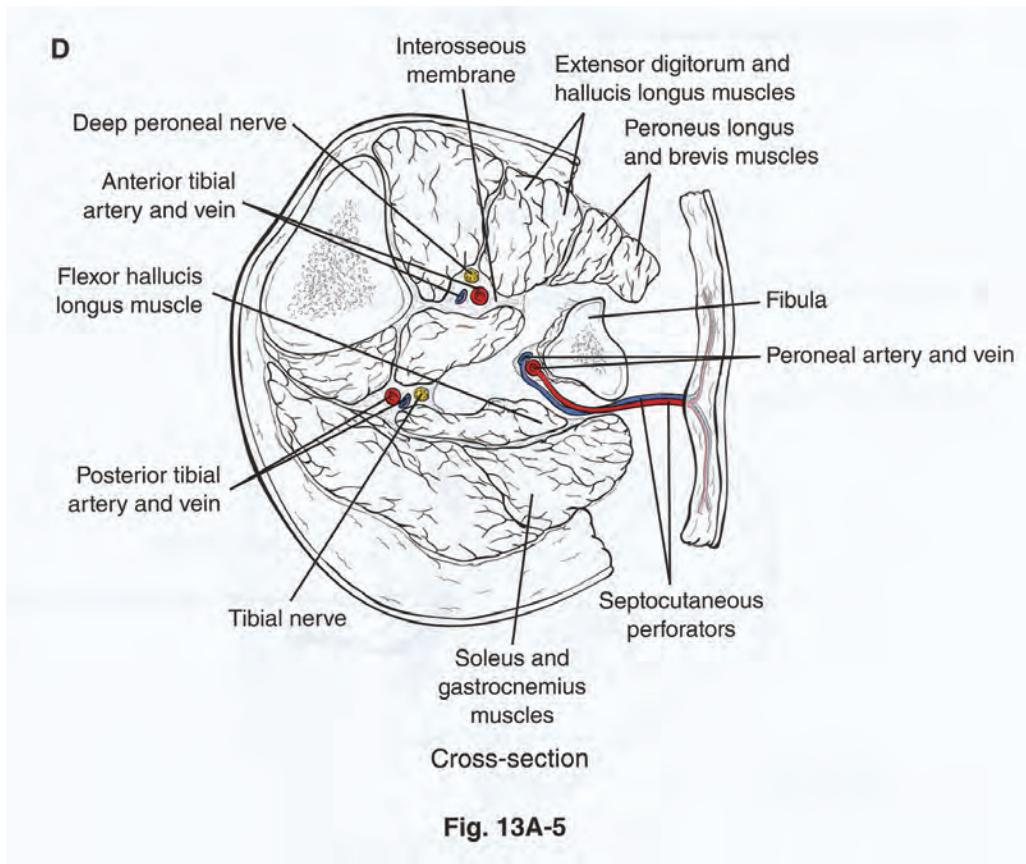
### ANATOMY OF THE FIBULA FLAP



**Fig. 13A-1**

**Dominant pedicle:** Peroneal artery

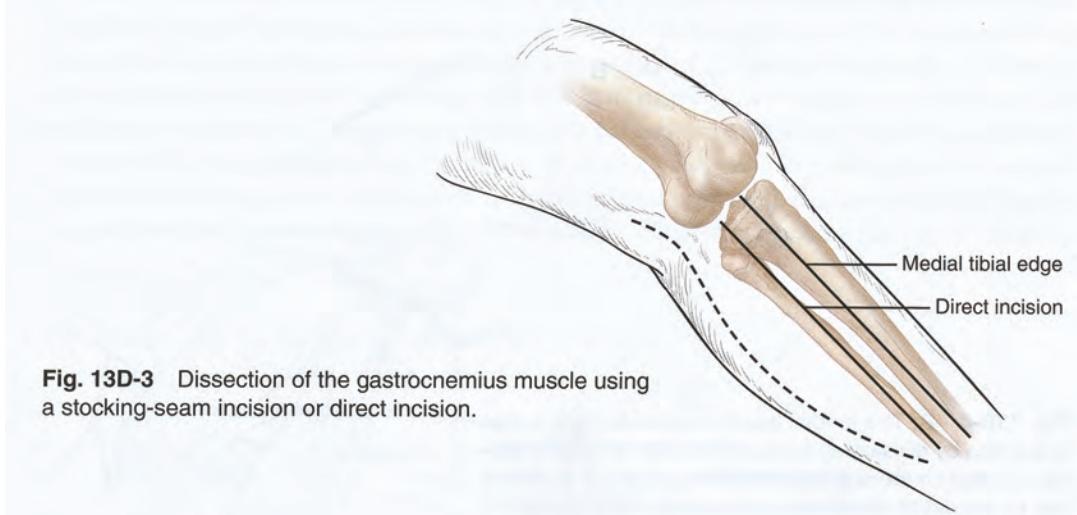
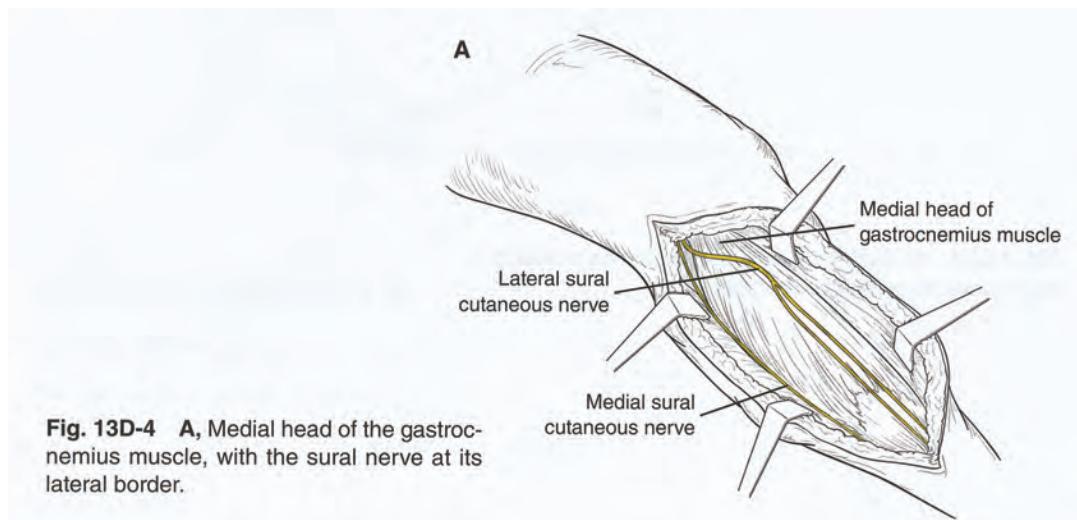
**Minor pedicles:** Lateral inferior genicular artery; anterior tibial artery



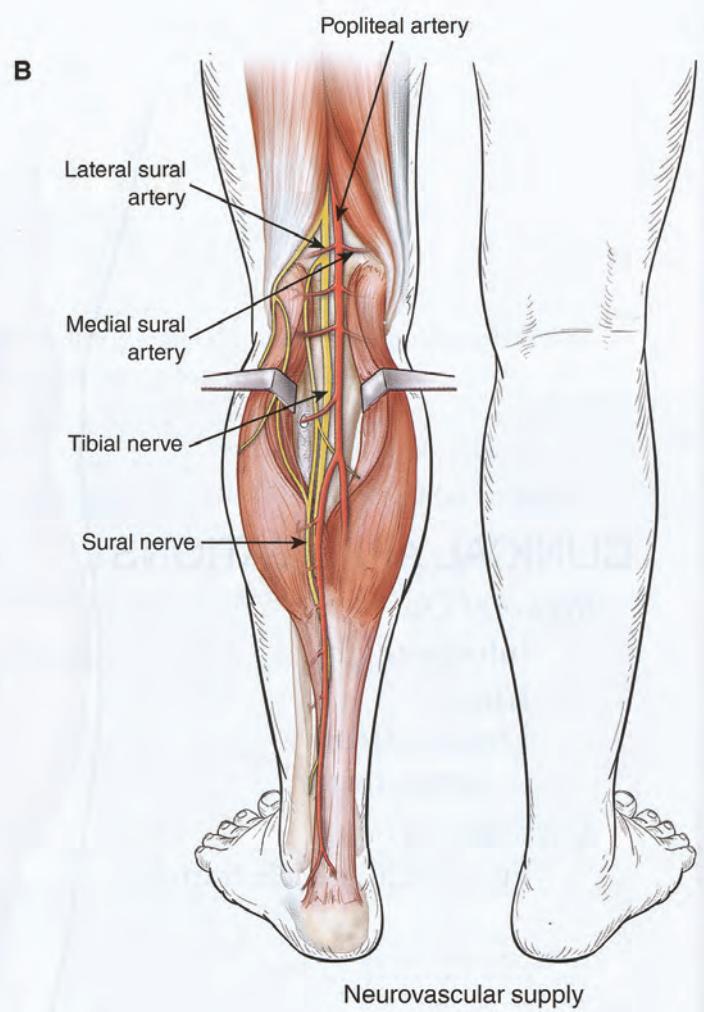
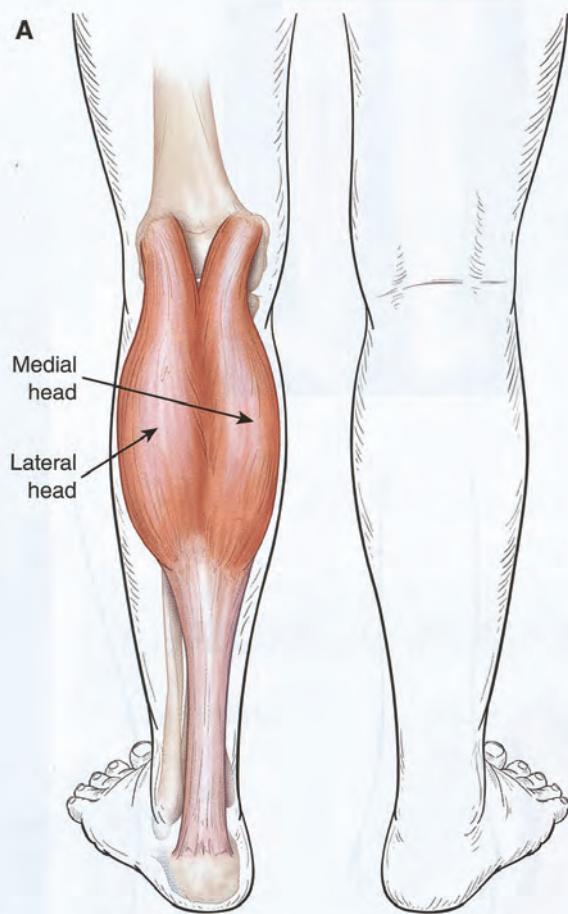
## **Flap: Gastrocnemius Flap**

<b>Tissues available:</b>	muscle, skin
<b>Vascular Anatomy:</b>	medial and lateral sural arteries
<b>Innervation:</b>	medial popliteal nerves (motor)
<b>Flap Dimensions:</b>	medial: 8 x 20 cm muscle, 10 x 23 cm skin lateral: 6 x 17 cm muscle, 10 x 23 cm skin
<b>Advantages:</b>	can split into medial and lateral heads, each with own neurovascular pedicle;
<b>Disadvantages:</b>	donor scars conspicuous; if skin is incorporated in flap, skin graft required to close donor site
<b>Things to note:</b>	minimal functional loss if only medial or lateral muscle used; medial muscle has greater arc of rotation; release proximal origin of muscle for greater arc of rotation and reach; partial muscle free flap described

### **Notes:**



## ANATOMY OF THE GASTROCNEMIUS FLAP



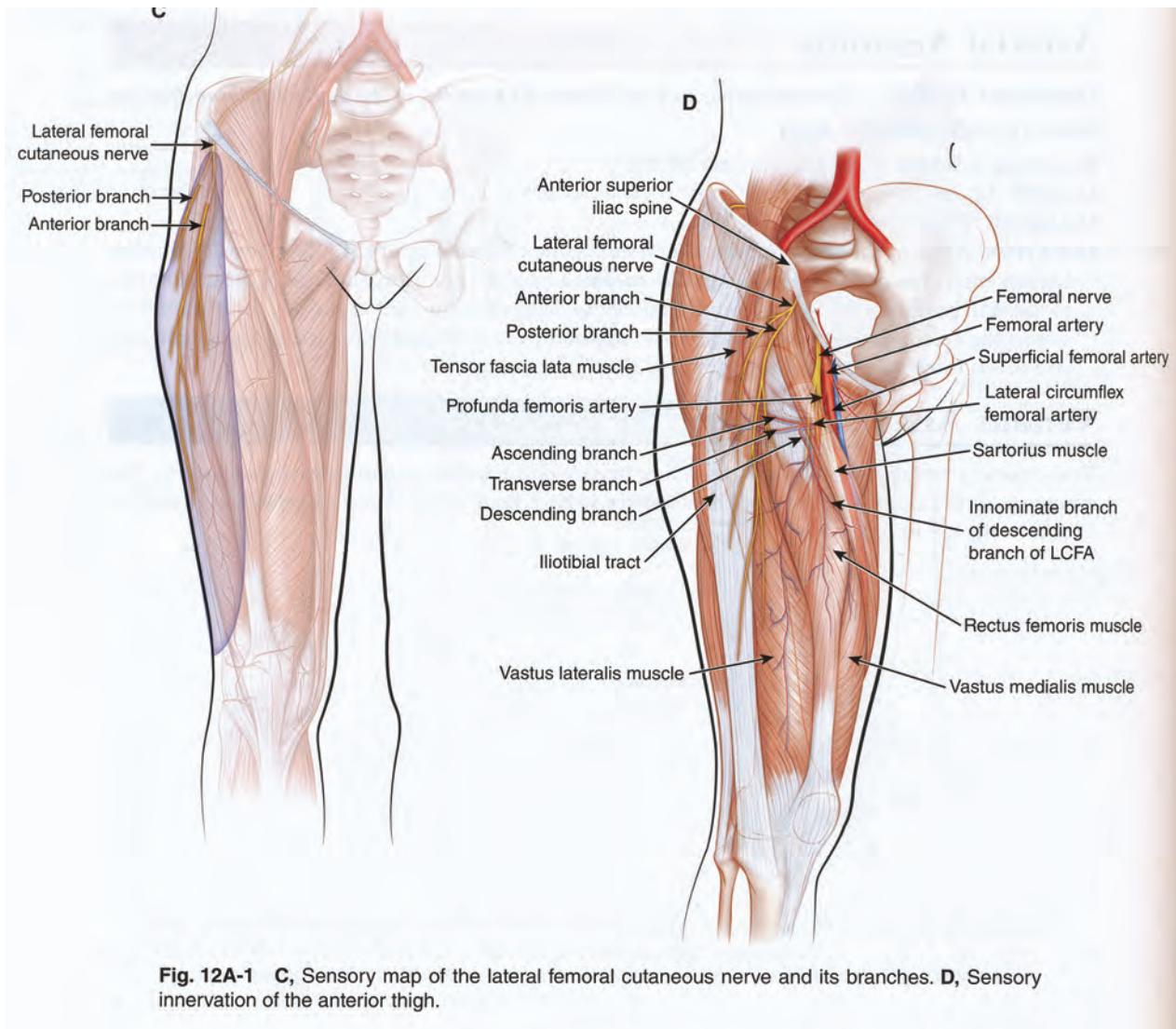
**Fig. 13D-1**

**Dominant pedicles:** Medial gastrocnemius, medial sural artery; lateral gastrocnemius, lateral sural artery

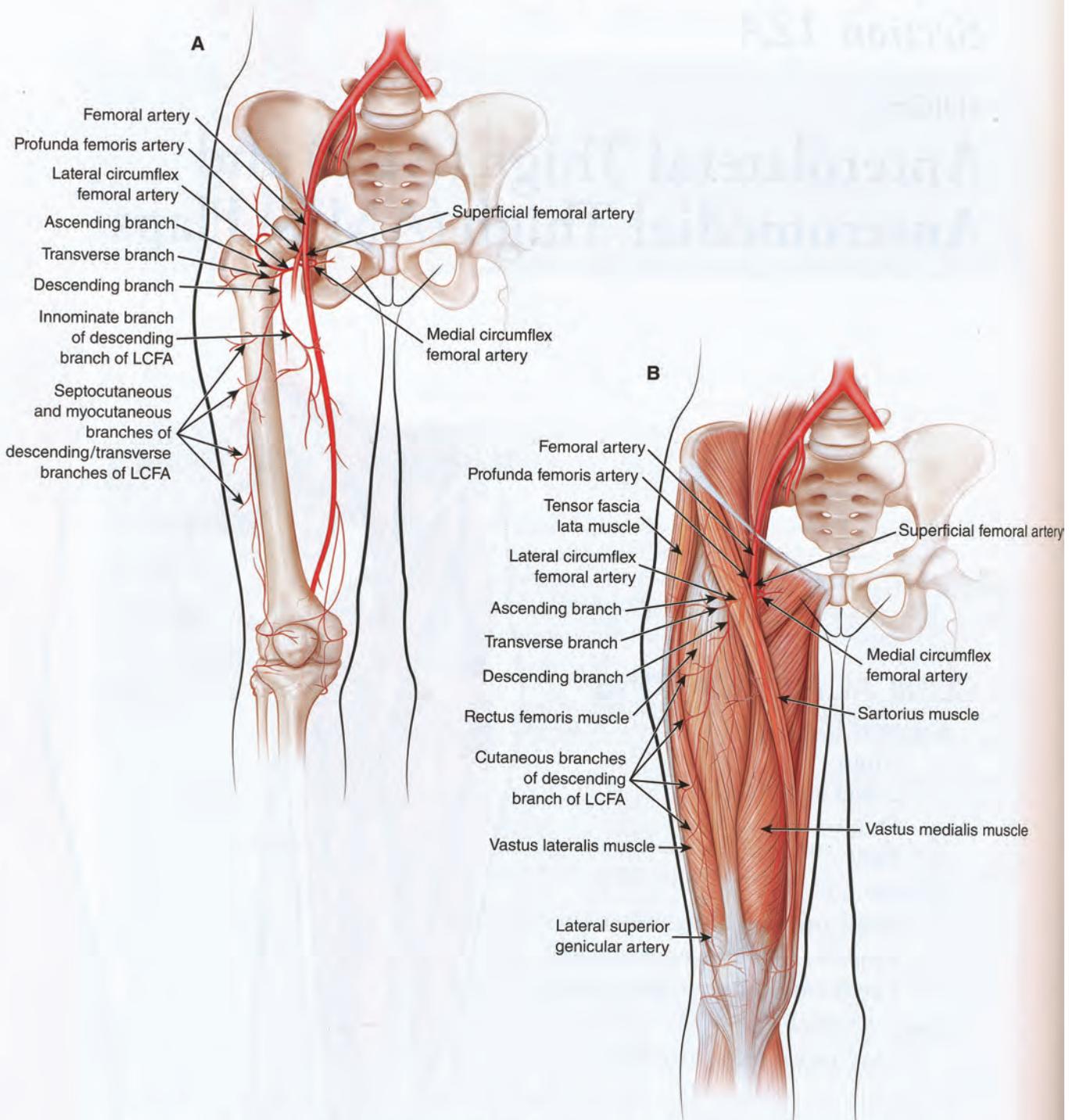
## **Flap: Anterior Lateral Thigh (ALT) Flap**

<b>Tissues available:</b>	fasciocutaneous, muscle
<b>Vascular Anatomy:</b>	descending branch of lateral circumflex femoral artery (2.1mm) and vein (2.3mm); pedicle length 8 –12 cm
<b>Innervation:</b>	lateral femoral cutaneous nerve
<b>Flap Dimensions:</b>	12 x 36 cm
<b>Advantages:</b>	thin, pliable in thin patients; rapid dissection; supine position for harvest
<b>Disadvantages:</b>	hair bearing; skin graft donor if greater than 9 cm wide; conspicuous donor
<b>Things to note:</b>	anteromedial thigh flap available if ALT vessels not present; if vessels course through muscle (60% of time) a portion of vastus lateralis muscle may be harvested or intramuscular dissection required

Notes:

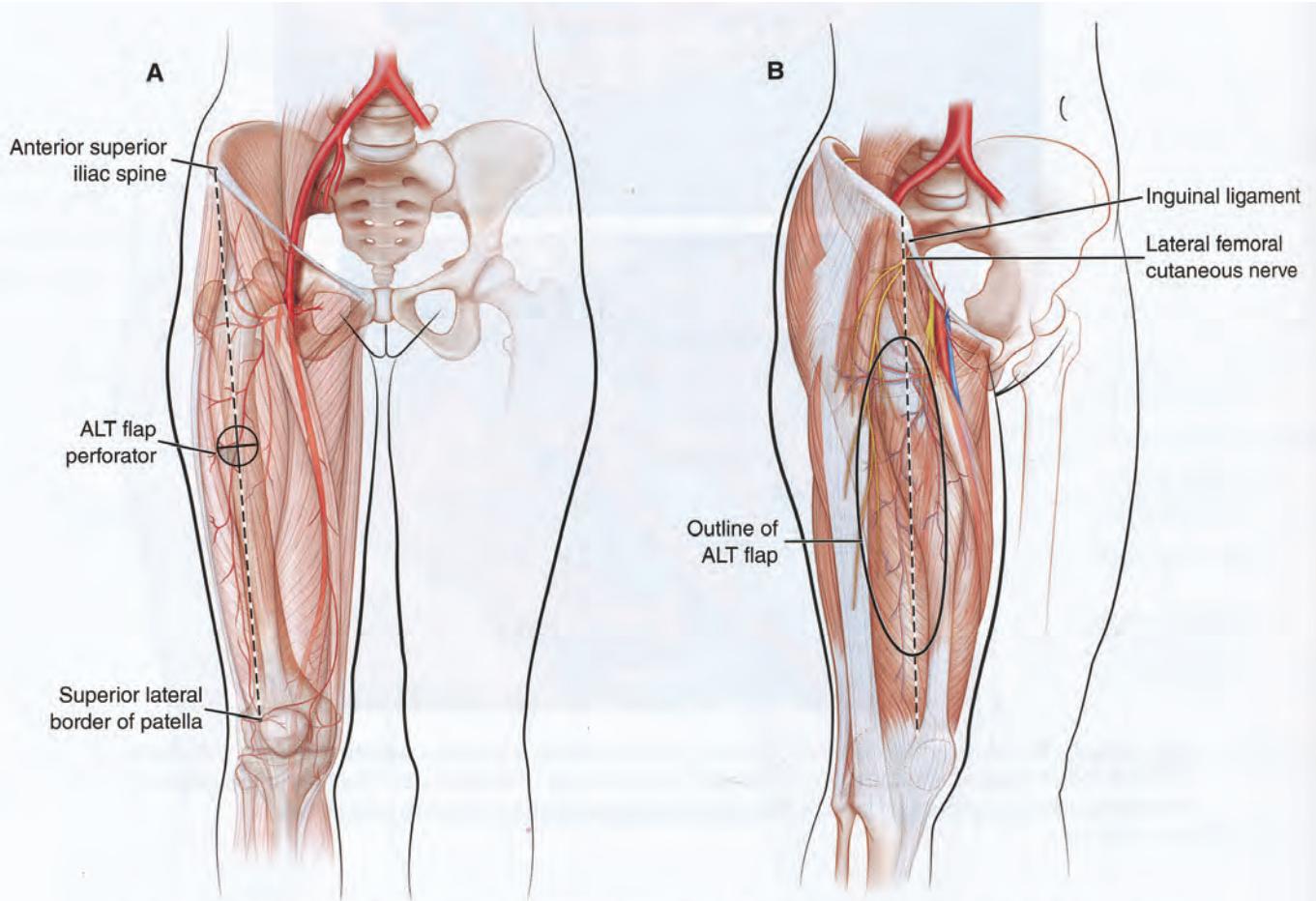


## ANATOMY OF THE ANTEROLATERAL THIGH (ALT) AND ANTEROMEDIAL THIGH (AMT) FLAPS



**Fig. 12A-1** **A**, The vascular anatomy of the thigh relevant to the ALT and AMT flaps. **B**, Anatomy of the lateral circumflex femoral artery and its branches and thigh vasculature.

**Dominant pedicle:** Septocutaneous and myocutaneous branches of descending branch of lateral circumflex femoral artery (LCFA)

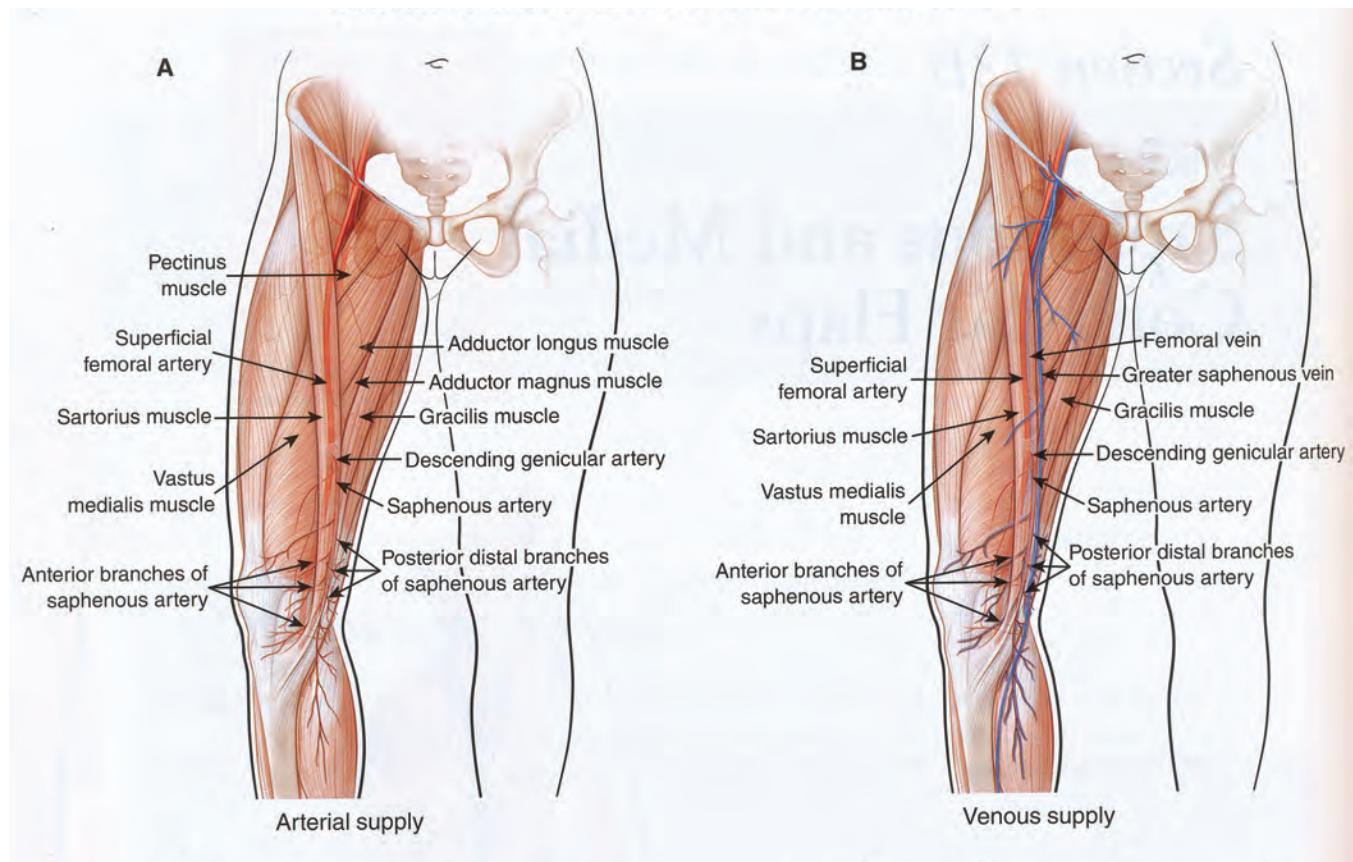


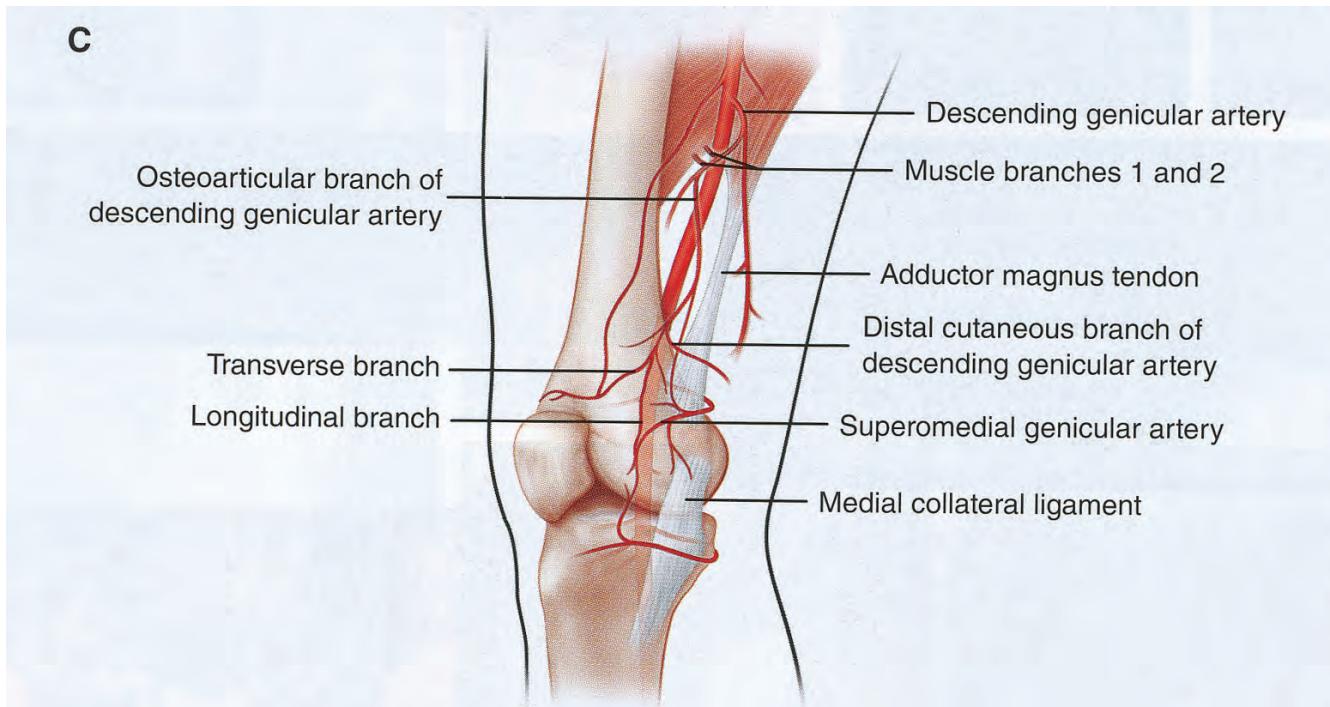
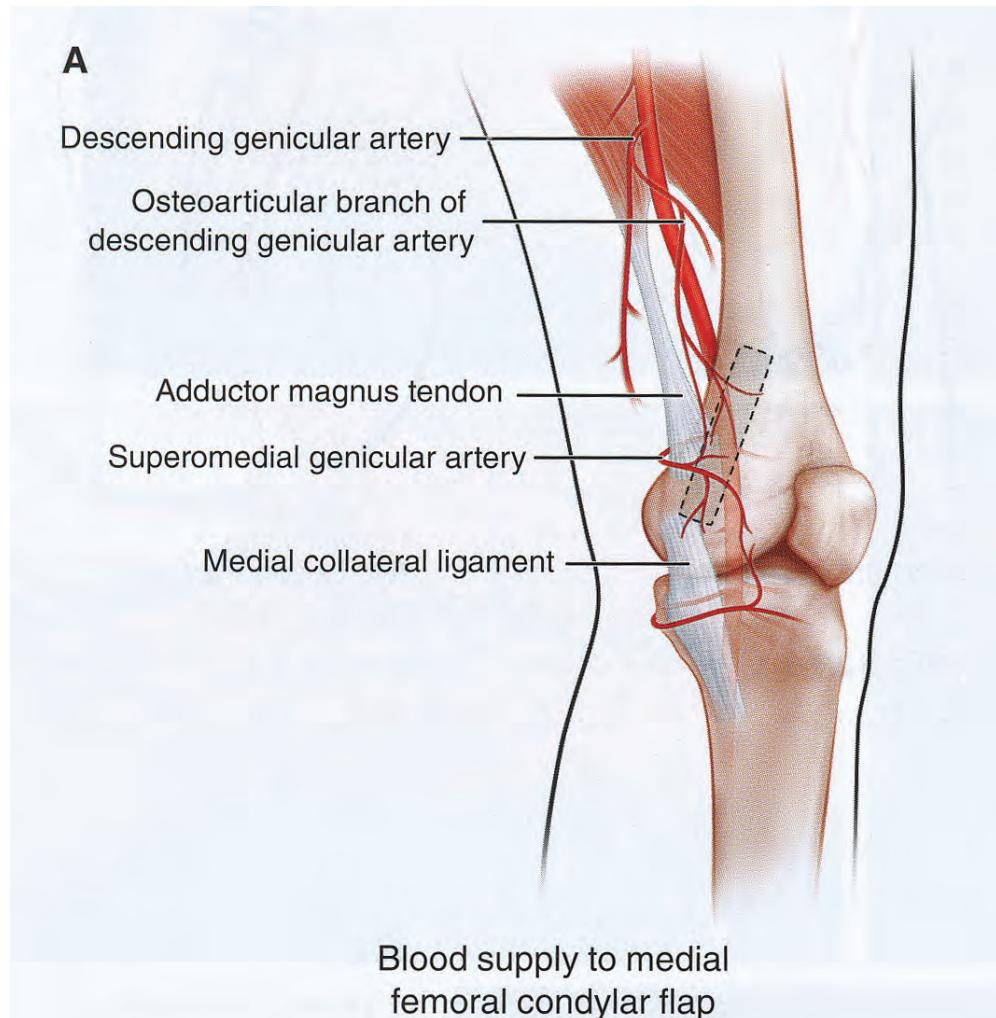
**Fig. 12A-3** **A**, With the patient in the supine position, the central axis of the flap is indicated by a line drawn from the anterior superior iliac spine to the superolateral border of the patella. The major fasciocutaneous perforators supplying the flap can be located at the midpoint of this line, within the lower, outer quadrant (*shaded area*) of a circle drawn with a radius of 3 cm. **B**, The medial flap border corresponds to the central axis of the rectus femoris muscle, denoted by the line drawn from the anterior superior iliac spine to the superior aspect of the patella. The lateral flap border extends to the midlateral thigh. The lateral circumflex femoral artery arises from the lateral side of the profunda femoris artery. It then passes laterally deep to the femoral nerve branches and the sartorius and rectus femoris muscles. It divides into ascending, transverse, and descending branches (and an innominate branch). Note the lateral femoral cutaneous nerve entering the thigh by passing under or through the lateral end of the inguinal ligament. The anterior branch can be employed to innervate the flap.

## Flap: Medial Femoral Condylar Flap

<b>Tissues available:</b>	bone, skin
<b>Vascular Anatomy:</b>	descending genicular artery(1.0-2.0mm) and vein(1.0-2.0mm) medial superior genicular artery(1.0-2.0mm) and vein(1.0-2.0mm)
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	bone up to 7 cm
<b>Advantages:</b>	acceptable donor morbidity (normal function, thin scar); 2 teams possible; provides corticocancellous graft of good size which is thin and pliable
<b>Disadvantages:</b>	learning curve, smaller vessels than iliac crest
<b>Things to note:</b>	vessel choice depends on dominance and pedicle length; saphenous branch of genicular artery can be taken if skin paddle is needed

**Notes:**



**C****A**

### **Flap: First Dorsal Metacarpal Flap (“Kite Flap”)**

<b>Tissues available:</b>	skin
<b>Vascular Anatomy:</b>	dorsal metacarpal artery(2-3 mm), comitantes and subcutaneous veins (3-5 mm)
<b>Innervation:</b>	superficial radial nerve
<b>Flap Dimensions:</b>	2 x 6 cm
<b>Advantages:</b>	sensate, thin, pliable; large vessel size for free flap; no sacrifice of digital vessels; donor scar acceptable over time
<b>Disadvantages:</b>	early donor scar conspicuous;
<b>Things to note:</b>	preserve extensor tendon paratenon; can include extensor indicis tendon, ? bone can base flap on metacarpals 2 – 4 (4 <sup>th</sup> dorsal metacarpal artery not always present

**Notes:**

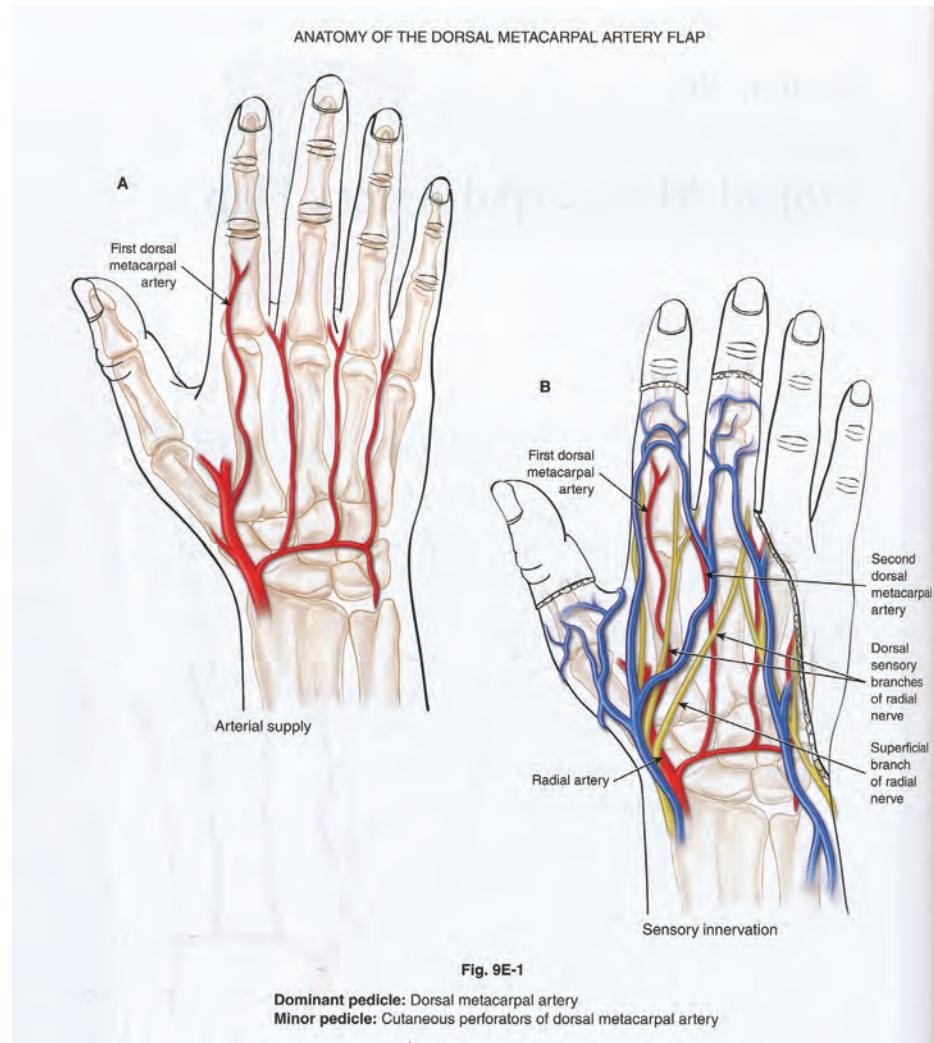


Fig. 9E-1

Dominant pedicle: Dorsal metacarpal artery

Minor pedicle: Cutaneous perforators of dorsal metacarpal artery

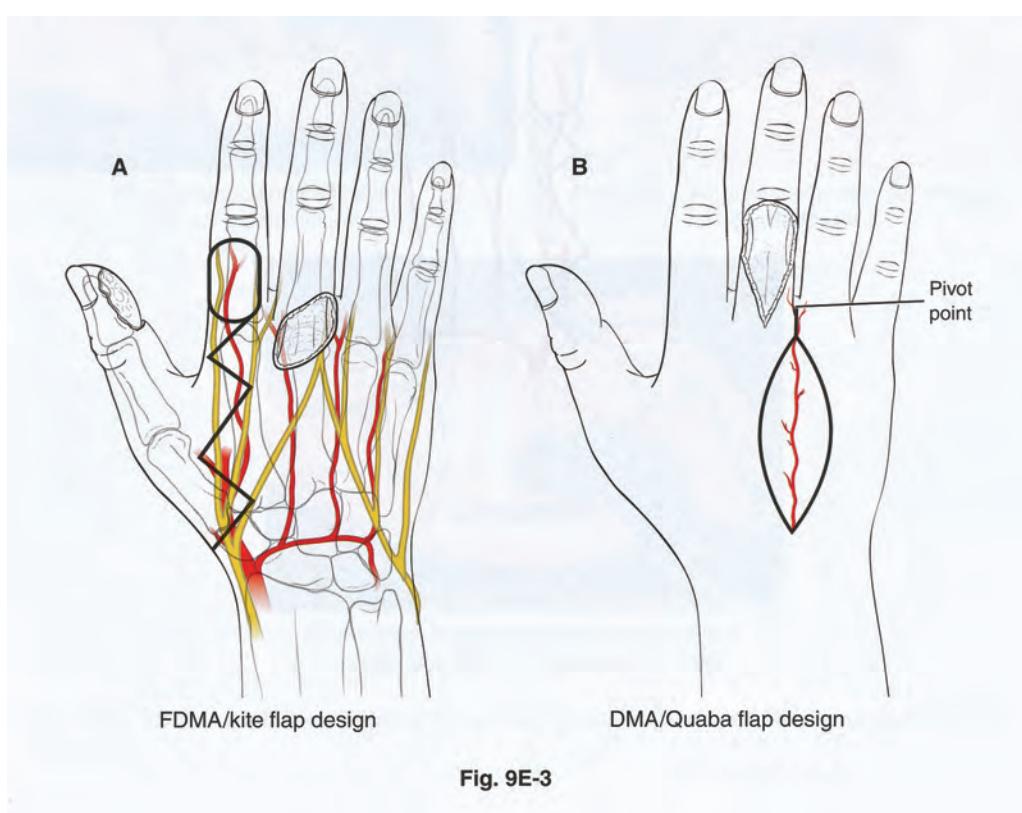
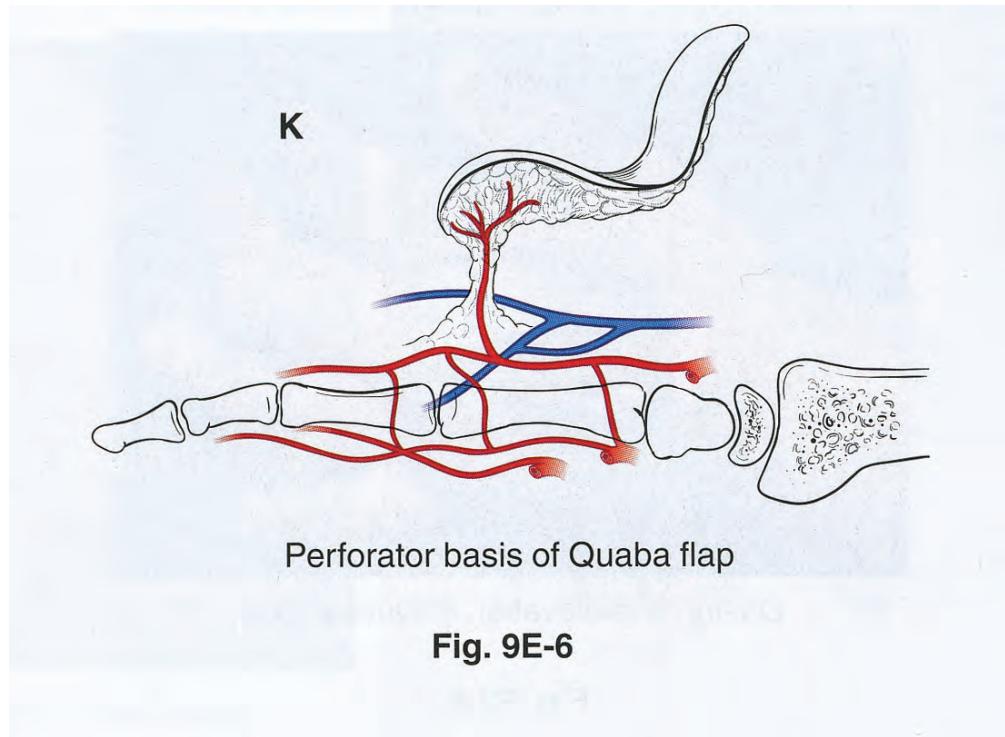
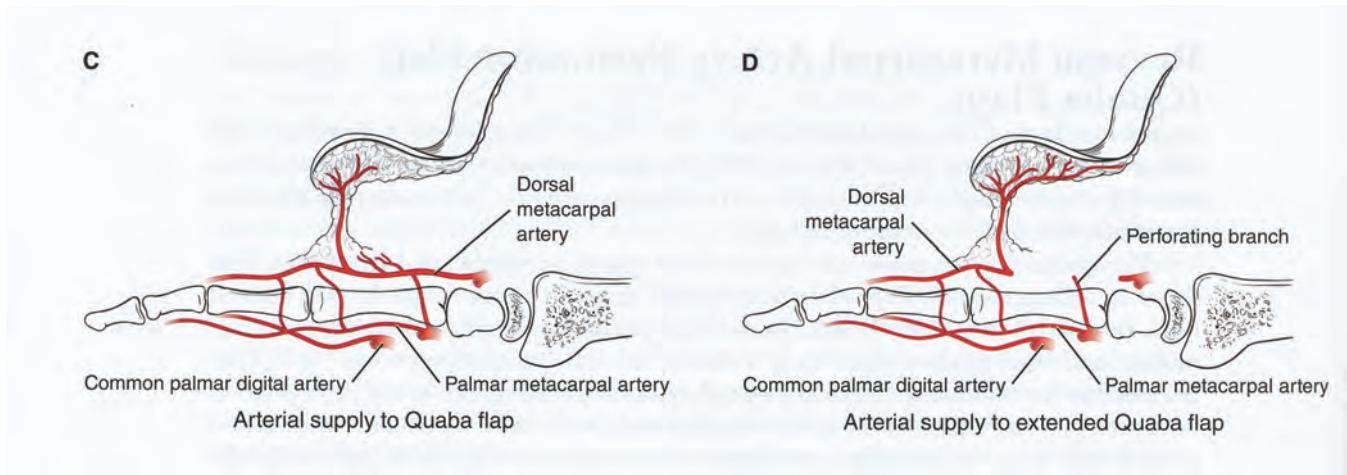
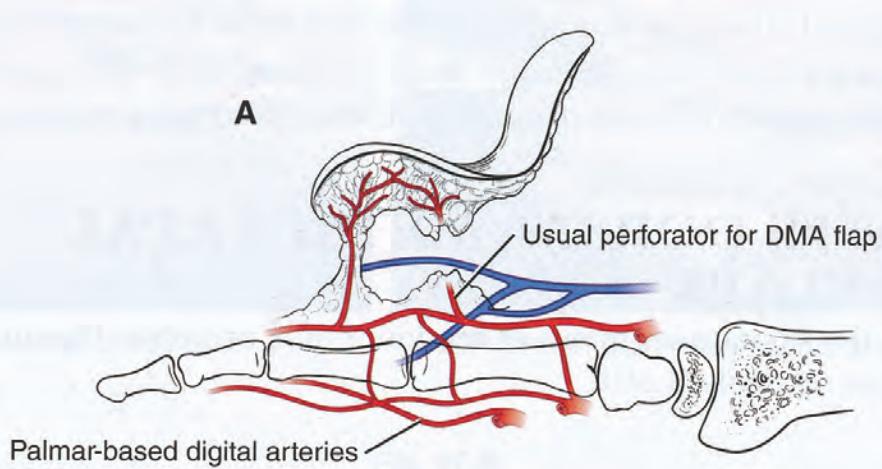


Fig. 9E-3



**Fig. 9E-6**

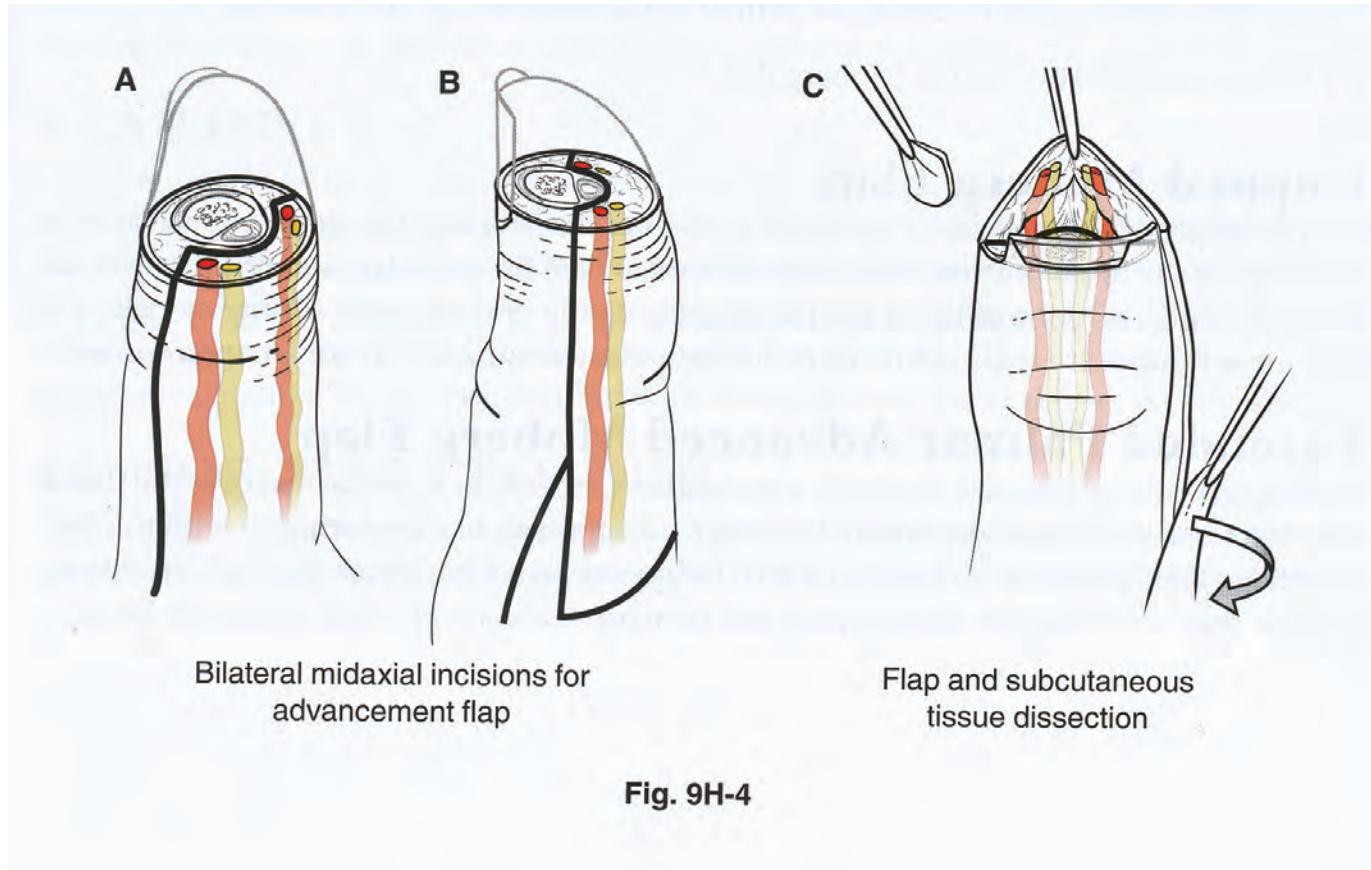


**Fig. 9E-7** A, Division of the usual perforator of the DMA flap, which allows shifting of the pivot point distally.

## **Flap: Volar Advancement Flap (Moberg)**

<b>Tissues available:</b>	skin
<b>Vascular Anatomy:</b>	digital artery
<b>Innervation:</b>	digital nerves
<b>Flap Dimensions:</b>	volar surface of thumb
<b>Advantages:</b>	simple dissection; sensate coverage of tip of thumb
<b>Disadvantages:</b>	limit of advancement 1.5 to 2 cm; flexion contracture of thumb
<b>Things to note:</b>	O'Brien modification- extra mobilization by dissecting neurovascular bundles and skin grafting donor; can place z-plasties at base

Notes:



## Flap: V to Y Fingertip Flap

**Tissues available:** skin

**Vascular Anatomy:** no pedicle

**Innervation:** no pedicle

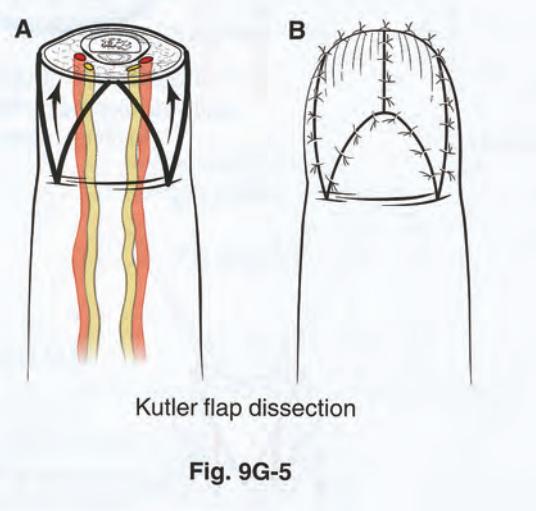
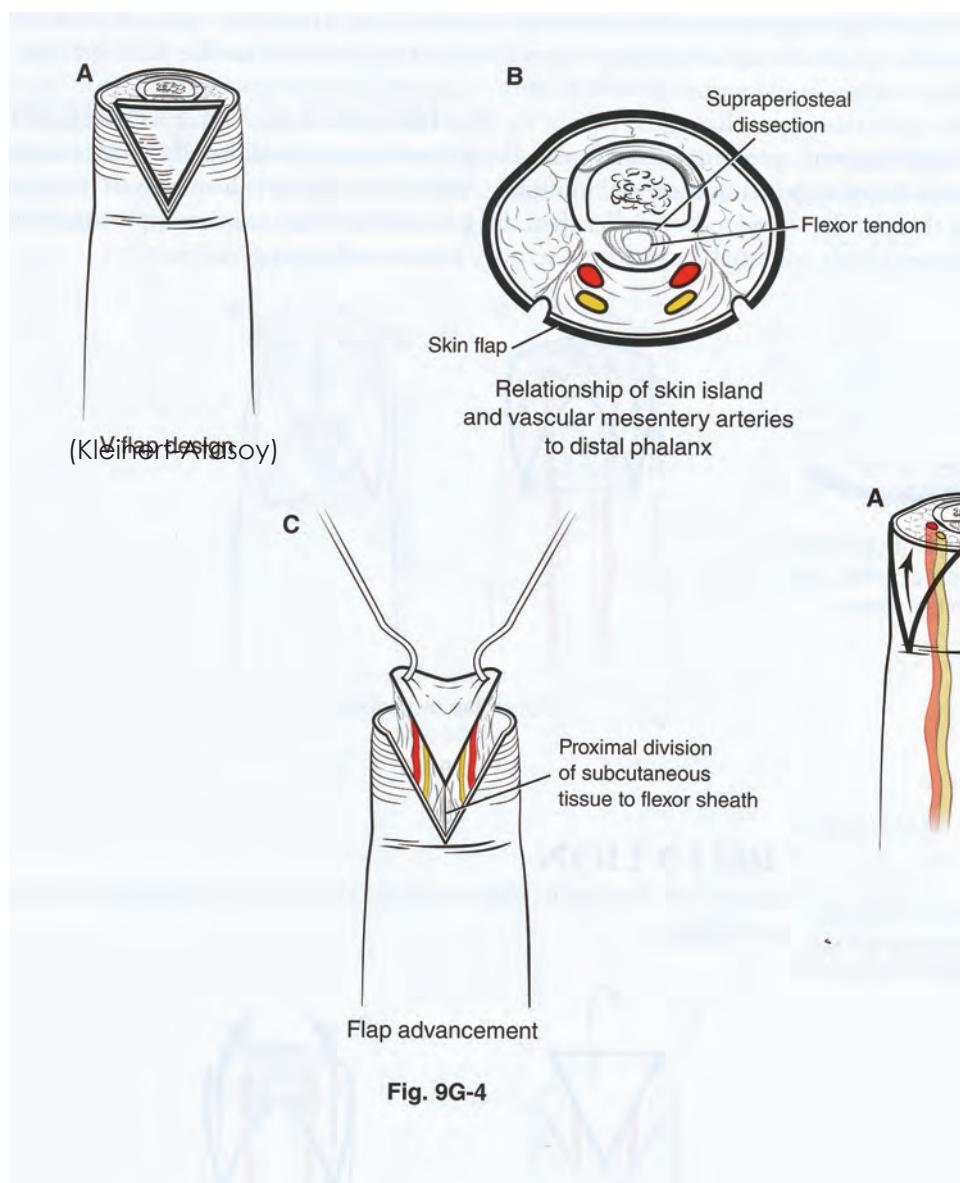
**Flap Dimensions:** 1 x 1.5cm

**Advantages:** simple dissection; sensate;

**Disadvantages:** size limitations

**Things to note:** volar based (Atasoy) or lateral based (Kutler); loose inset to maximize vascularity

**Notes:**



## Flap: Homodigital/Heterodigital Island Flap

**Tissues available:** skin

**Vascular Anatomy:** digital artery and vein, proximally or distally based

**Innervation:** digital nerve

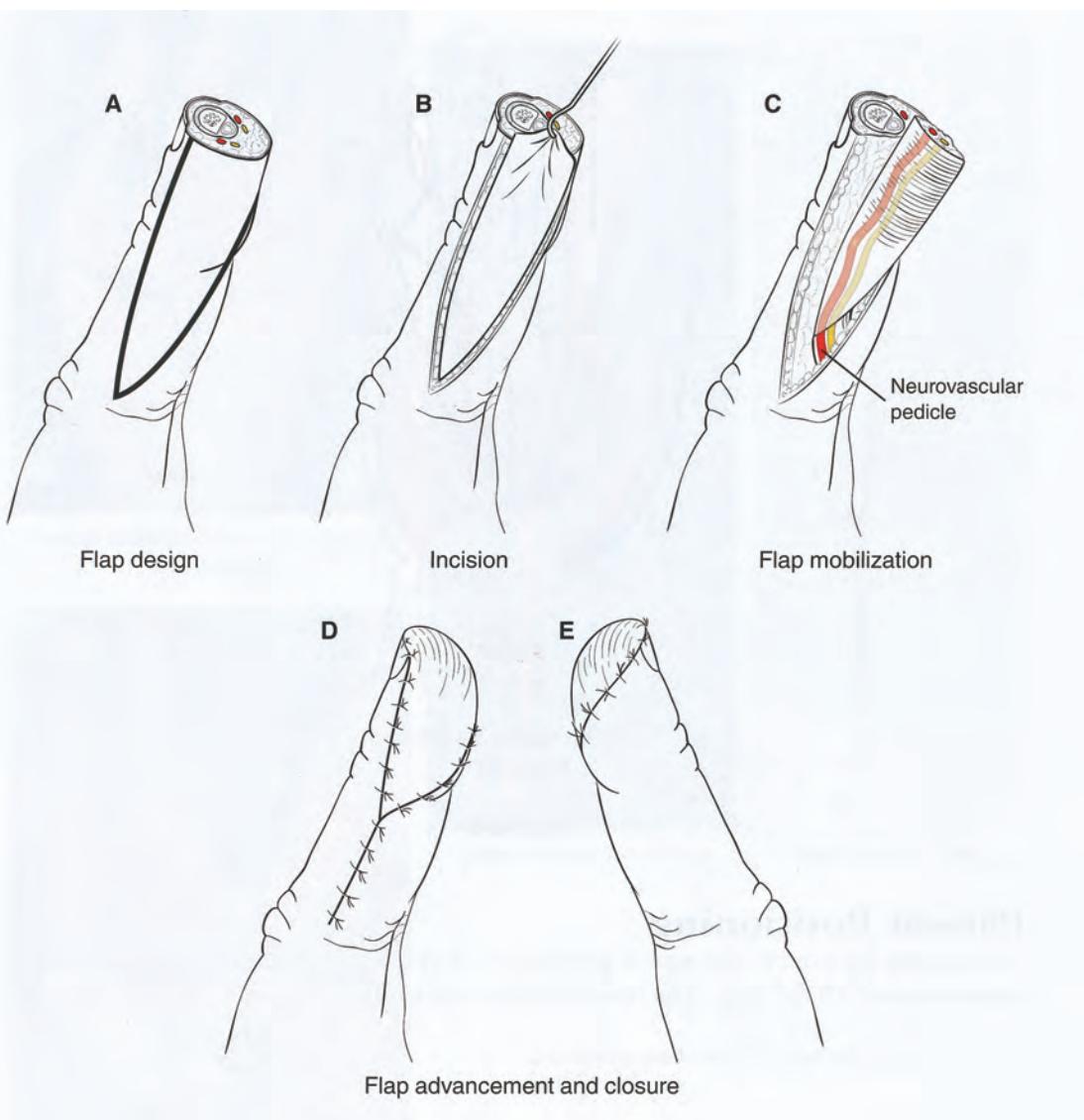
**Flap Dimensions:** 1.5 x 2.5 cm

**Advantages:** good coverage over exposed joints (MP and PIP)

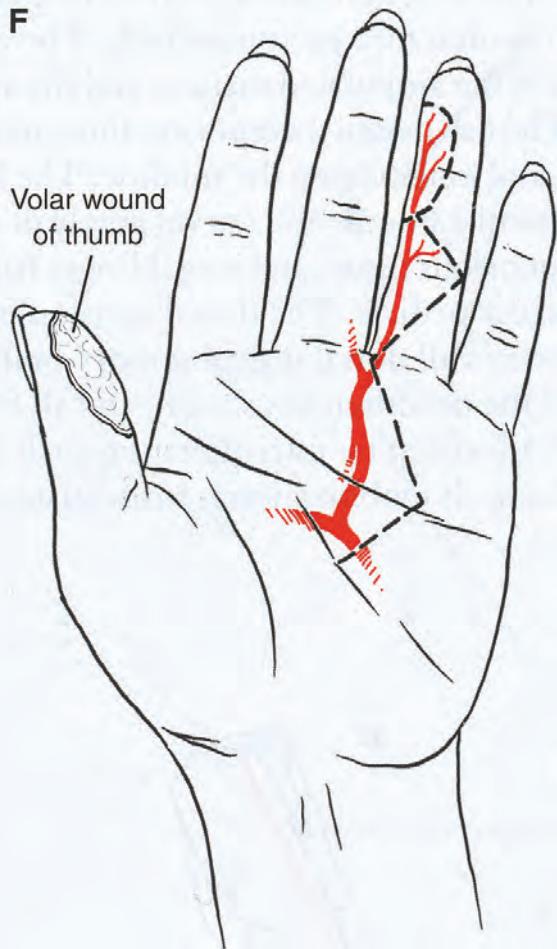
**Disadvantages:** difficult dissection;

**Things to note:** pre-op digital Allen's test; dissect nerve free or include in flap; FTSG donor site; donor may be same or neighboring digit

**Notes:**

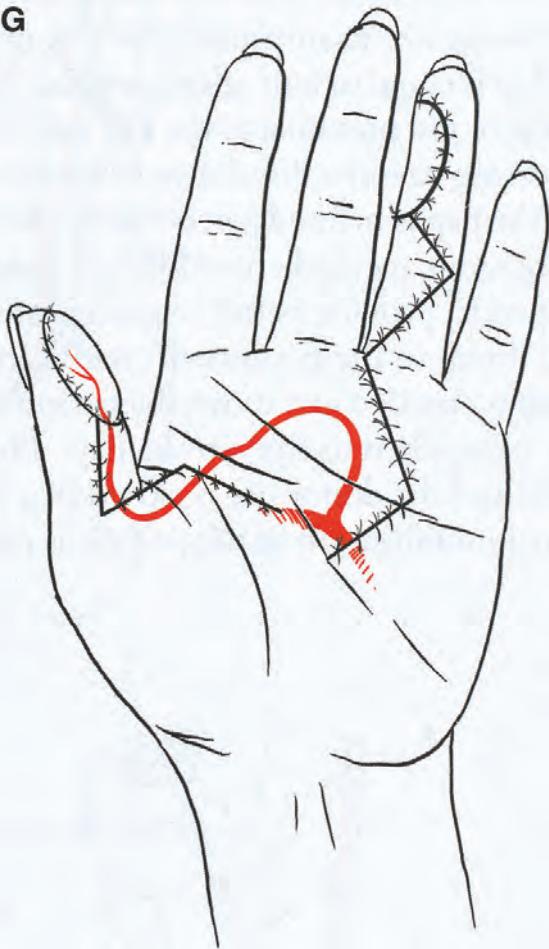


**F**



Flap design from radial side of ring finger  
to resurface volar thumb wound

**G**



Tunneled flap inset with full-thickness  
skin graft to donor site

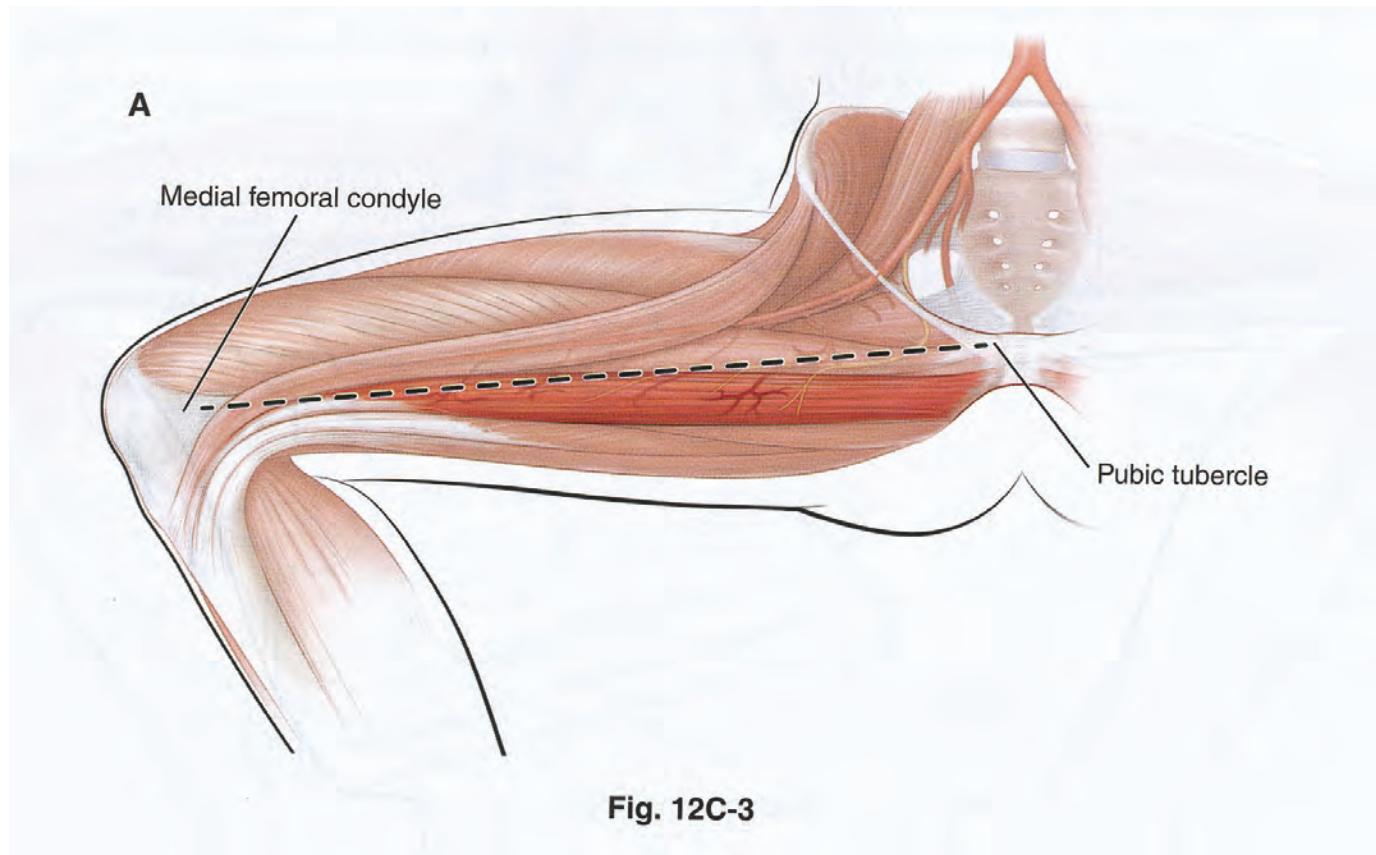
**Fig. 9C-4**

Heterodigital Flap Design

## **Flap: Gracilis Flap**

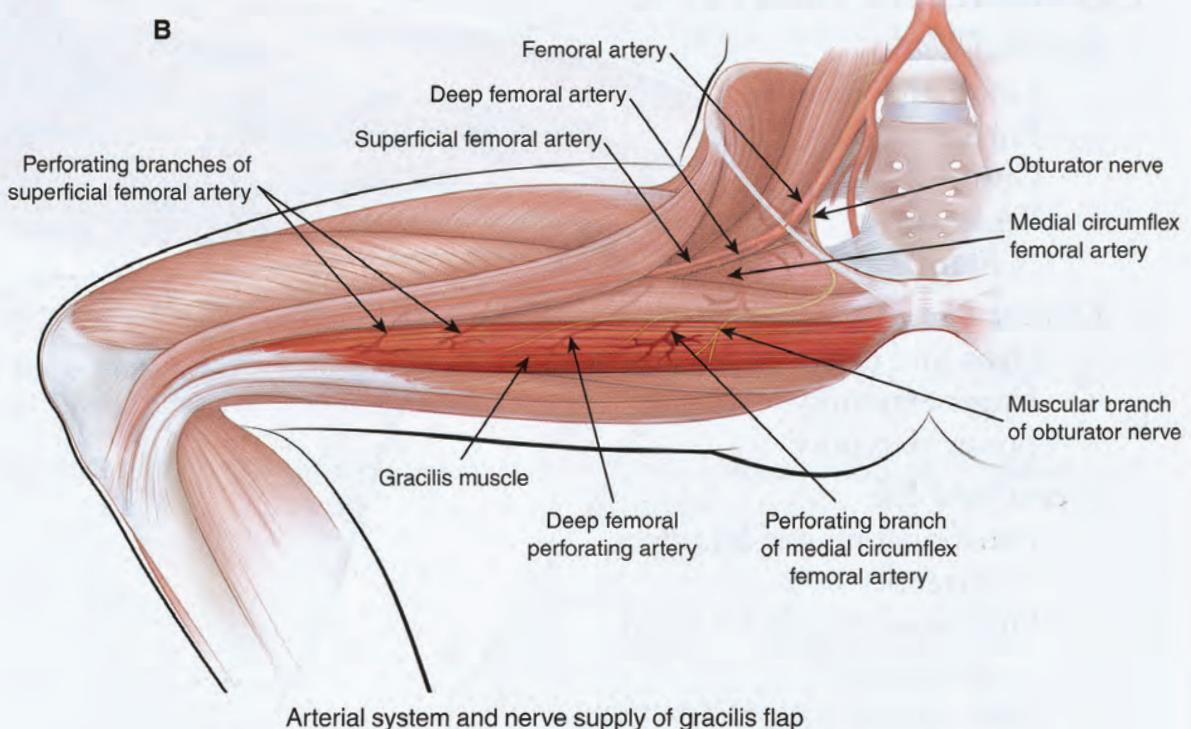
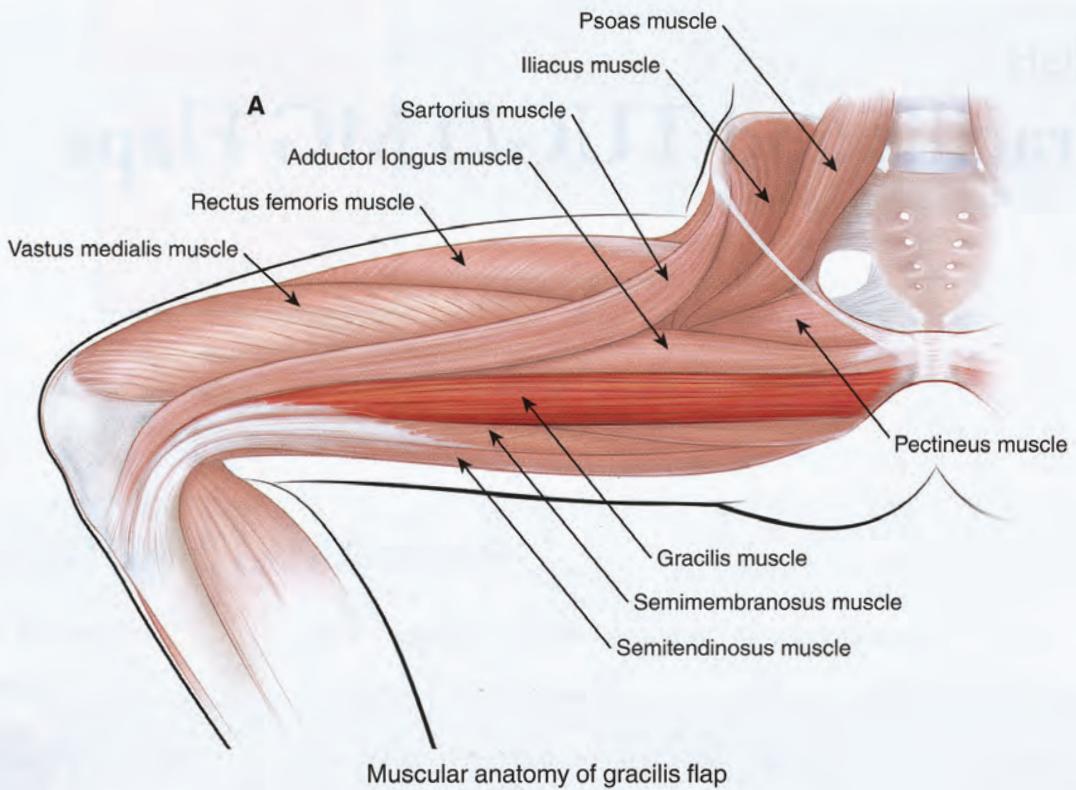
<b>Tissues available:</b>	skin, muscle
<b>Vascular Anatomy:</b>	medial femoral circumflex artery(1.0-1.8mm) and vein(1.5-3.0mm); pedicle length 6-7cm; minor pedicles enter distally from the profunda femoris
<b>Innervation:</b>	anterior obturator nerve (motor); medial cutaneous nerve of the thigh(sensory)
<b>Flap Dimensions:</b>	8x12 cm
<b>Advantages:</b>	expendable innervated muscle for functional transfer or coverage; acceptable scar location
<b>Disadvantages:</b>	no skin paddle in distal 1/3; skin paddle can be unreliable, especially distally; seromas
<b>Things to note:</b>	improve skin viability by incorporating muscle fascia from the neighboring muscles during harvest to insure incorporation of skin perforators; distally sartorius overlies gracilis and can be confused for it; can harvest part of the innervated muscle flap by fascicular distribution; transverse skin paddle increase described for breast reconstruction

**Notes:**



**Fig. 12C-3**

## ANATOMY OF THE GRACILIS FLAP



**Fig. 12C-1**

**Dominant pedicle:** Medial circumflex femoral artery

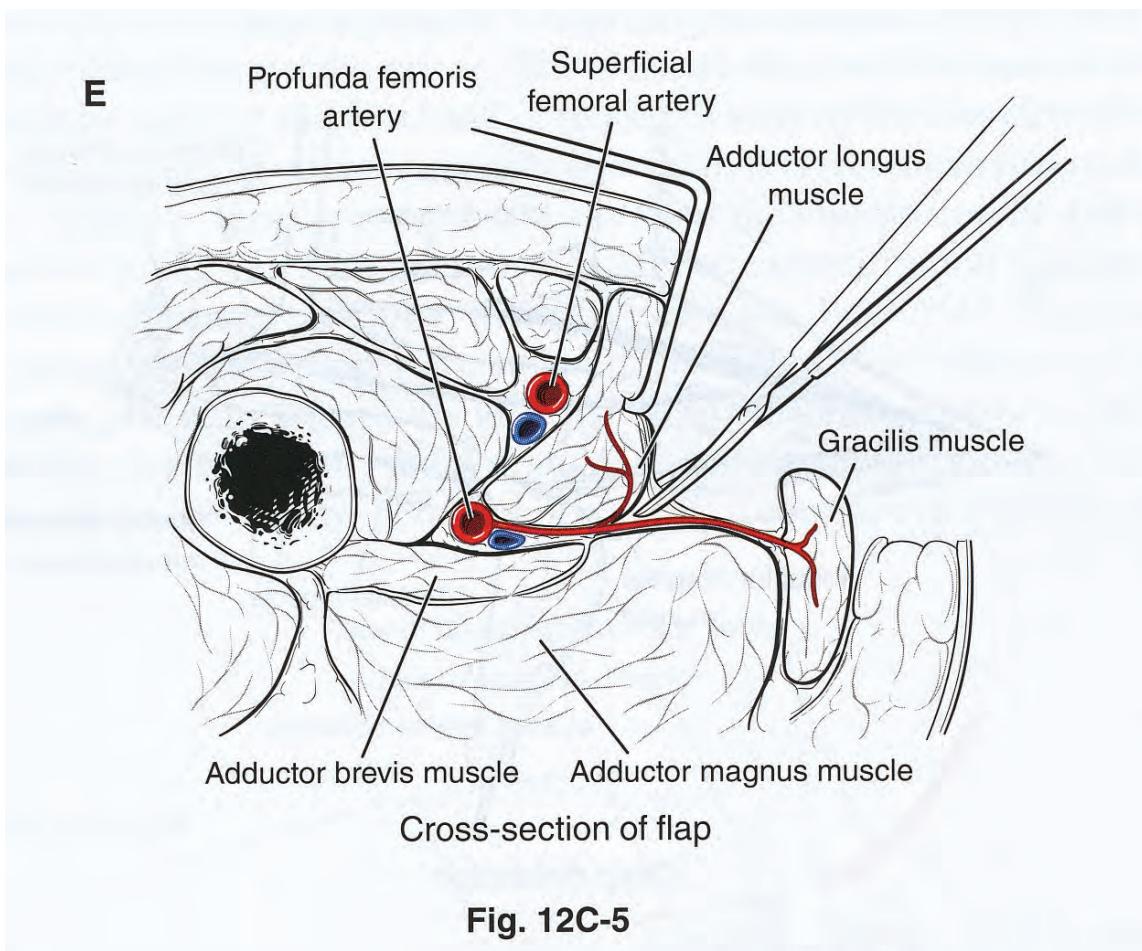
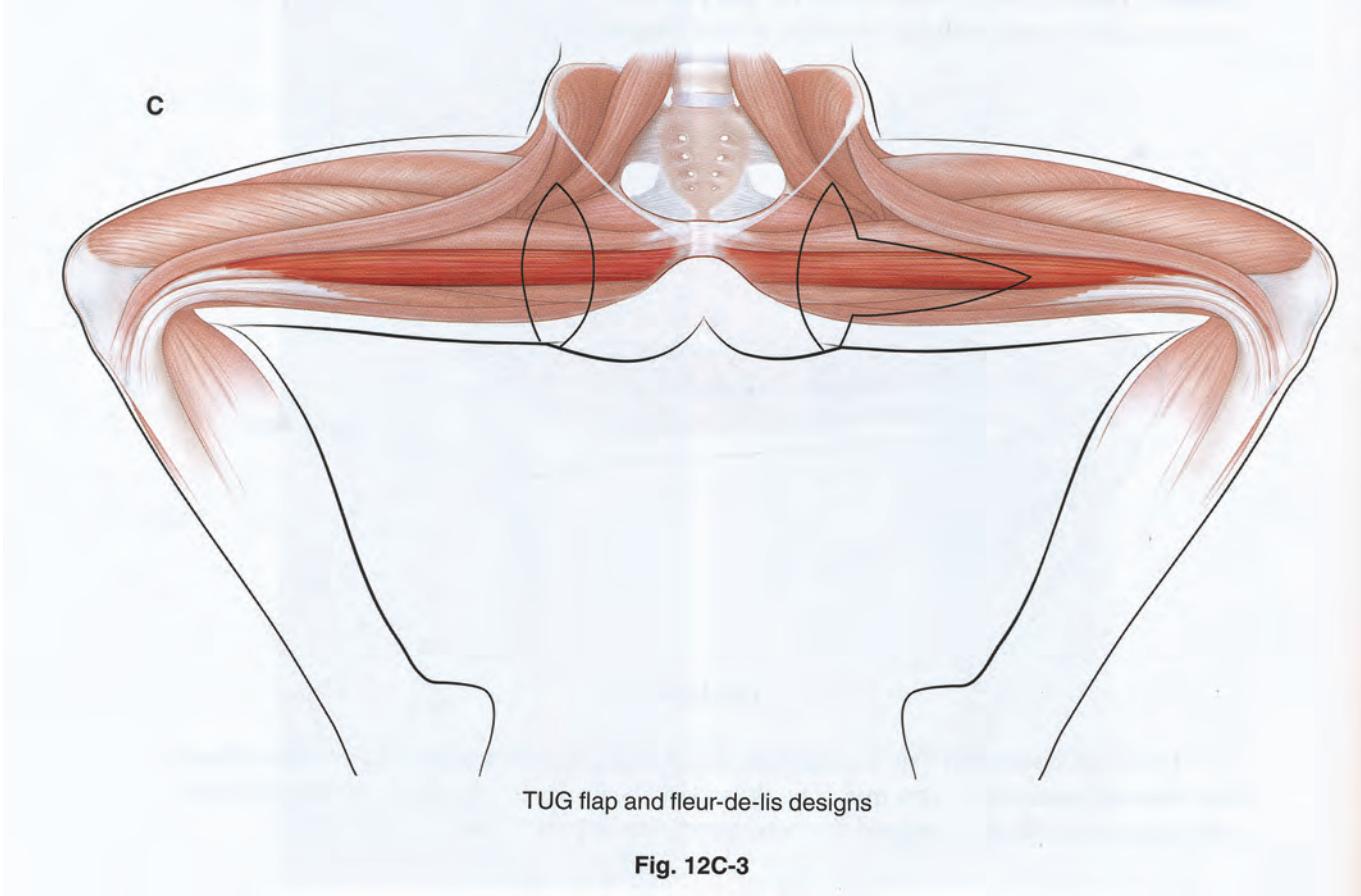
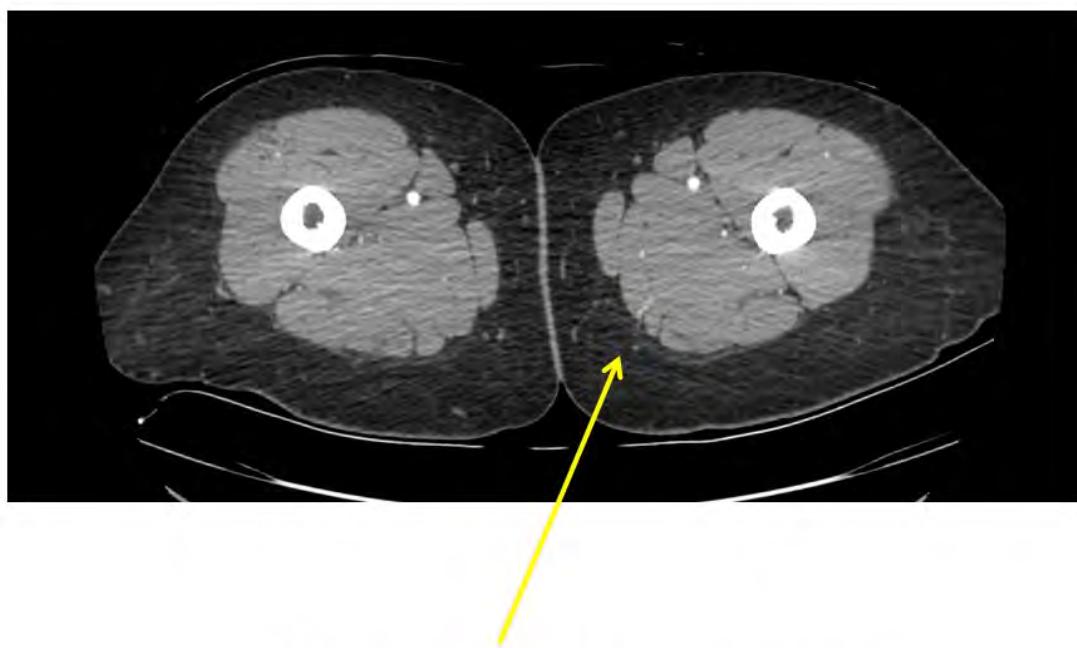


Fig. 12C-5

## **Flap: Profunda Femoris Artery Perforator (PAP) Flap**

<b>Tissues available:</b>	skin
<b>Vascular Anatomy:</b>	Perforating vessels off the profunda femoris artery traveling through the adductor magnus muscle.
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	skin: 8 x 26 cm
<b>Advantages:</b>	concealed donor site scar
<b>Disadvantages:</b>	May have a small caliber vessels (<2mm), donor site may be painful during sitting, flap is relatively long and thin. Pre-operative studies needed.
<b>Things to note:</b>	Patient selection is key, excess tissue in the posterior thigh is needed. May harvest in the lithotomy position. Dissection is done anterior to posterior.

**Notes:**



Perforator through adductor from profunda artery



Pre-op markings



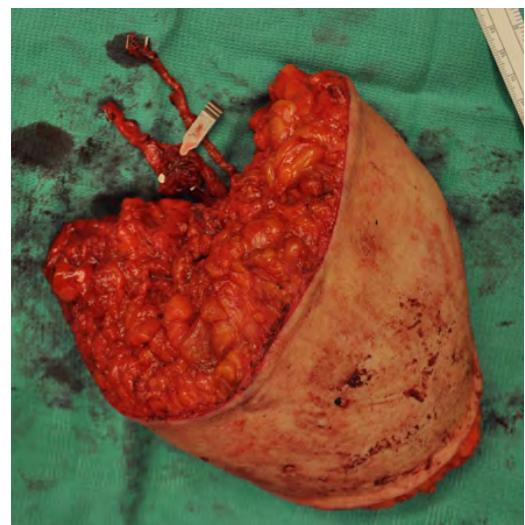
Post-op donor site



Flap pedicle in-situ



Flap 8 X 26 cm



Flap folded into breast shape

## **Flap: Medial Plantar Flap**

<b>Tissues available:</b>	fasciocutaneous
<b>Vascular Anatomy:</b>	medial plantar artery
<b>Innervation:</b>	medial plantar nerve
<b>Flap Dimensions:</b>	6 x 8 cm (limited by non-weightbearing area of foot)
<b>Advantages:</b>	“like” tissue for heel reconstruction
<b>Disadvantages:</b>	technically difficult, medial plantar artery may be absent, divides AHL
<b>Things to note:</b>	include fascia of the abductor hallucis in the flap; intraneuronal dissection of nerve

Notes:



**Fig. 14E-3**

Medial Plantar Flap design

### ANATOMY OF THE MEDIAL PLANTAR ARTERY FLAP

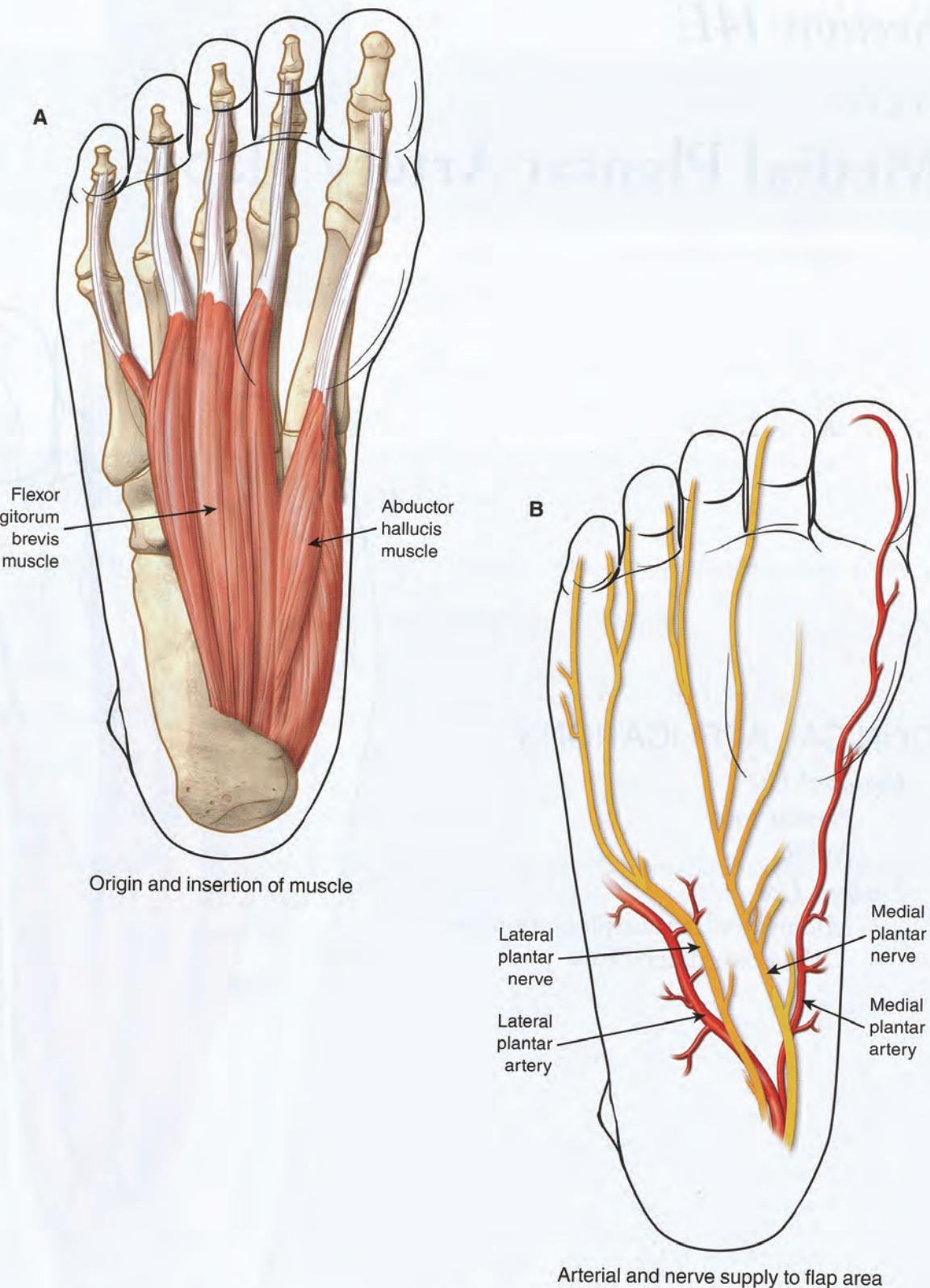


Fig. 14E-1

**Dominant pedicle:** Medial plantar artery

## Flap: Sural Flap

**Tissues available:** fasciocutaneous

**Vascular Anatomy:** superficial sural artery and commitantes; lesser saphenous vein

**Innervation:** none

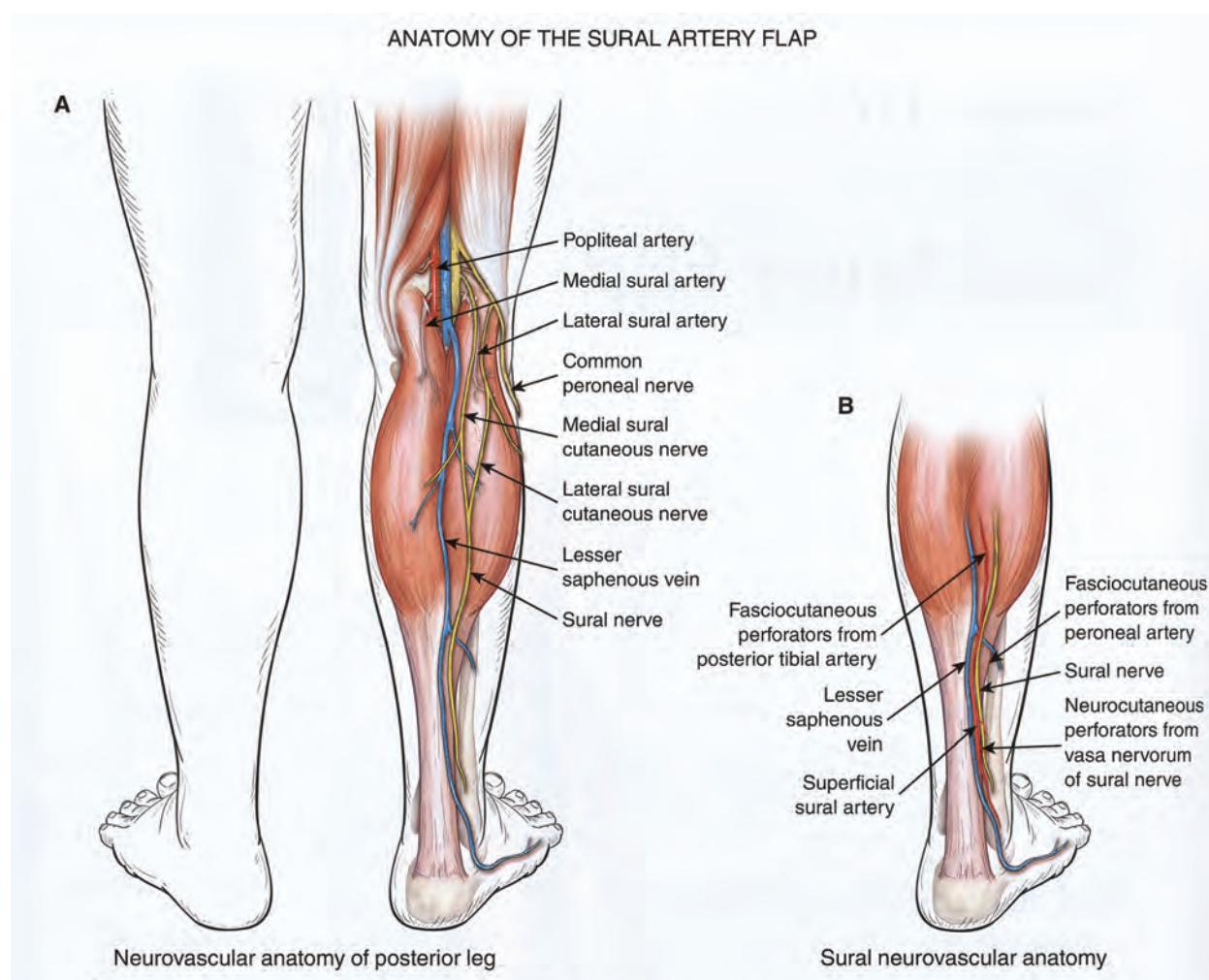
**Flap Dimensions:** 15 x 17 cm

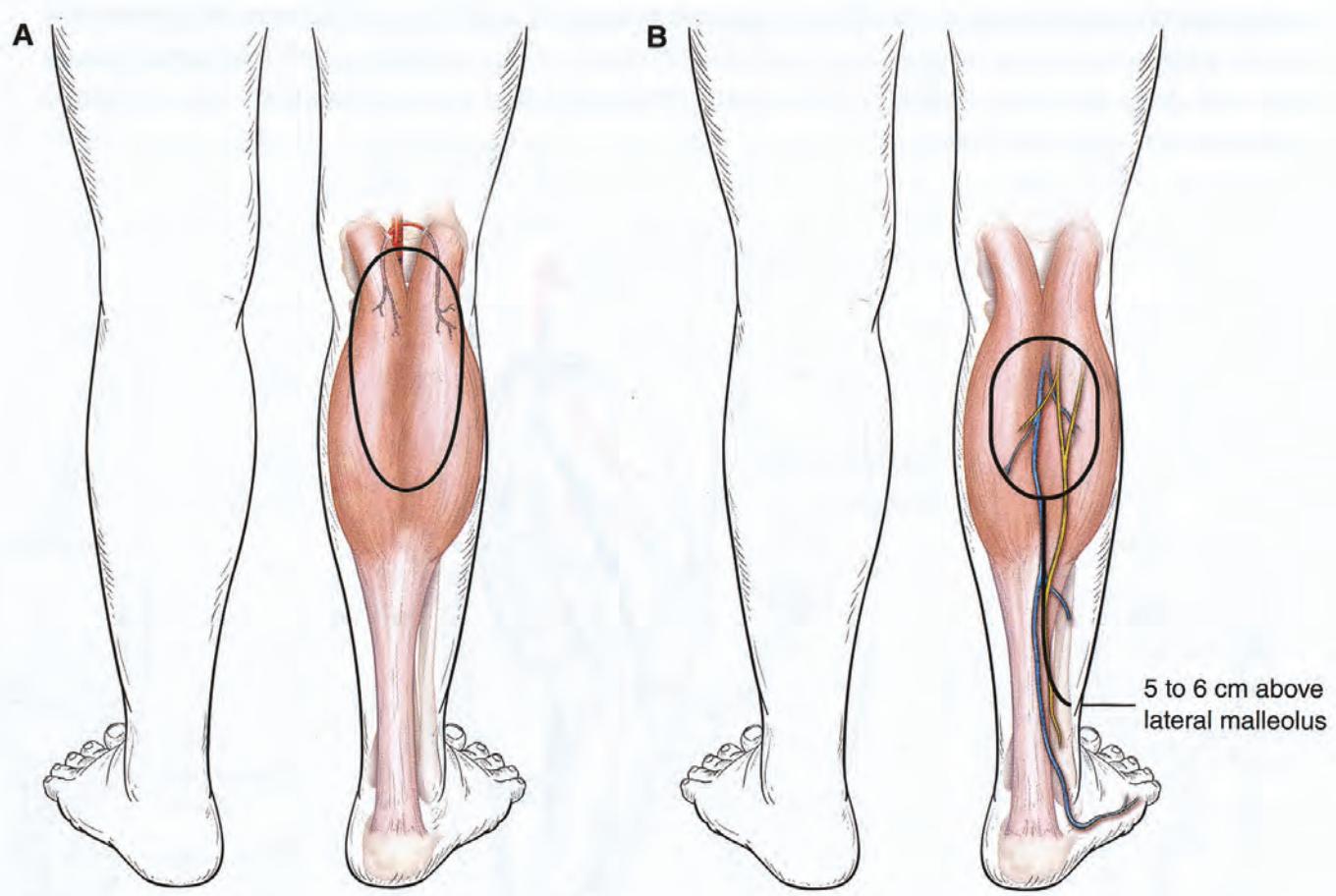
**Advantages:** easy dissection; avoids microsurgery; no major arteries sacrificed

**Disadvantages:** donor site appearance with skin graft poor; sural nerve distribution numbness (lateral foot)

**Things to note:** tourniquet dissection; can extend flap to popliteal crease; increased safety by avoiding a subcutaneous tunnel (can inset flap and divide and inset flap after 2 weeks); include skin over the pedicle for increased safety; primary closure possible if less than 3-4 cm wide

**Notes:**





**Fig. 13C-3** **A**, Design for anterograde flap. **B**, The design of the distally based superficial sural artery flap on the posterior aspect of the leg. The skin island can be raised anywhere in the lower two thirds of the leg. The pivot point of the pedicle must be at least 5 cm above the lateral malleolus to keep the anastomoses with the peroneal artery.

## **Flap: Lateral Arm Flap**

<b>Tissues available:</b>	skin, adipofascial, bone
<b>Vascular Anatomy:</b>	posterior radial collateral artery(1.5-2.0 mm) and vena comitantes (2.0-2.5mm) and cephalic vein
<b>Innervation:</b>	posterior cutaneous forearm nerve
<b>Flap Dimensions:</b>	8 x 15 cm
<b>Advantages:</b>	supine positioning; hidden scar in clothes; may take portion of humerus or strip of tendon from triceps
<b>Disadvantages:</b>	lateral forearm numbness; possibly bulky in some patients; skin grafted donor unsightly if primary closure not possible
<b>Things to note:</b>	primary closure if width 6 cm or less; can be raised anterograde for free flap, retrograde for pedicled flap; extend pedicle for free flap by moving design distally; visualize radial nerve to protect it

**Notes:**

## ANATOMY OF THE LATERAL ARM FLAP

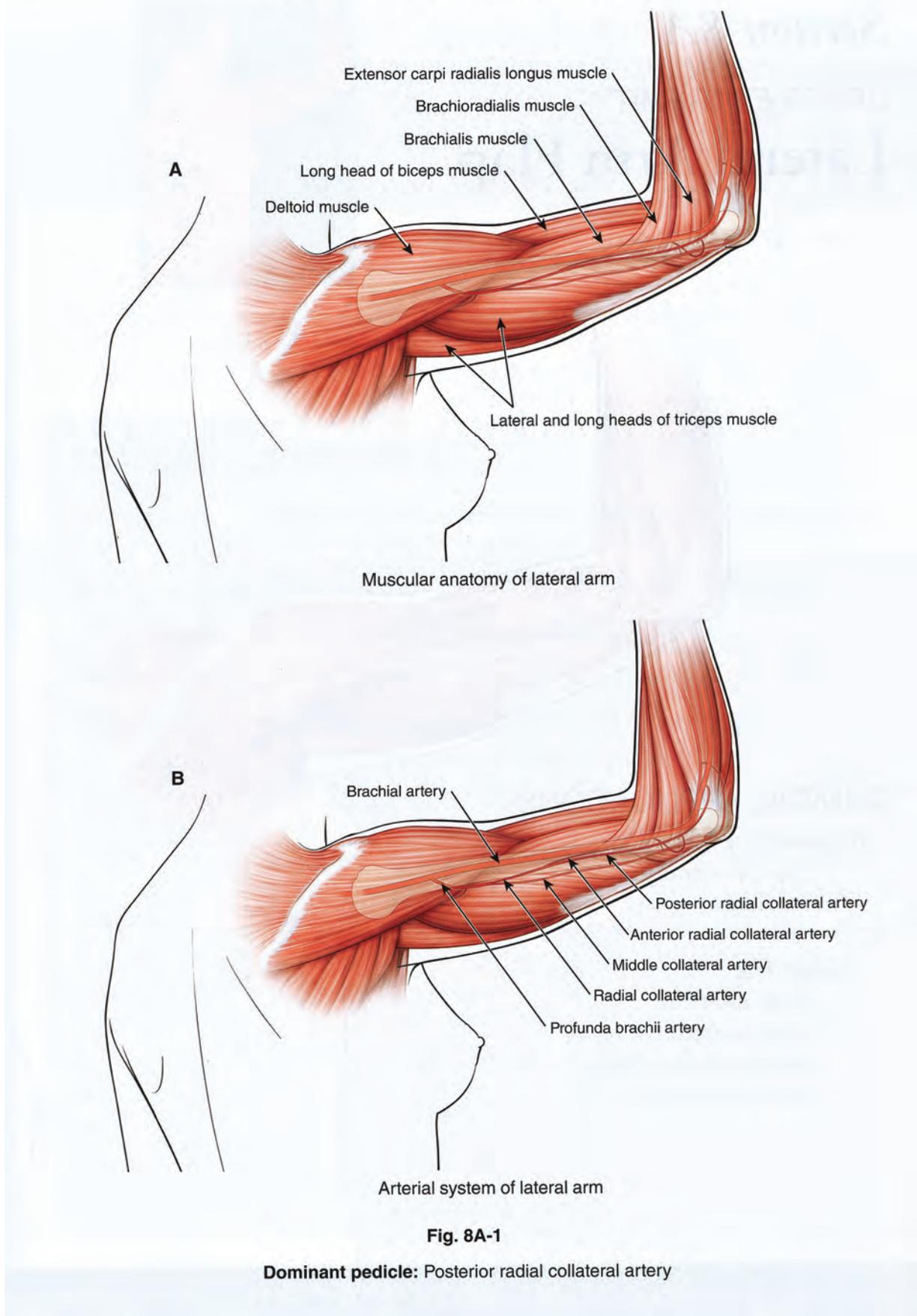
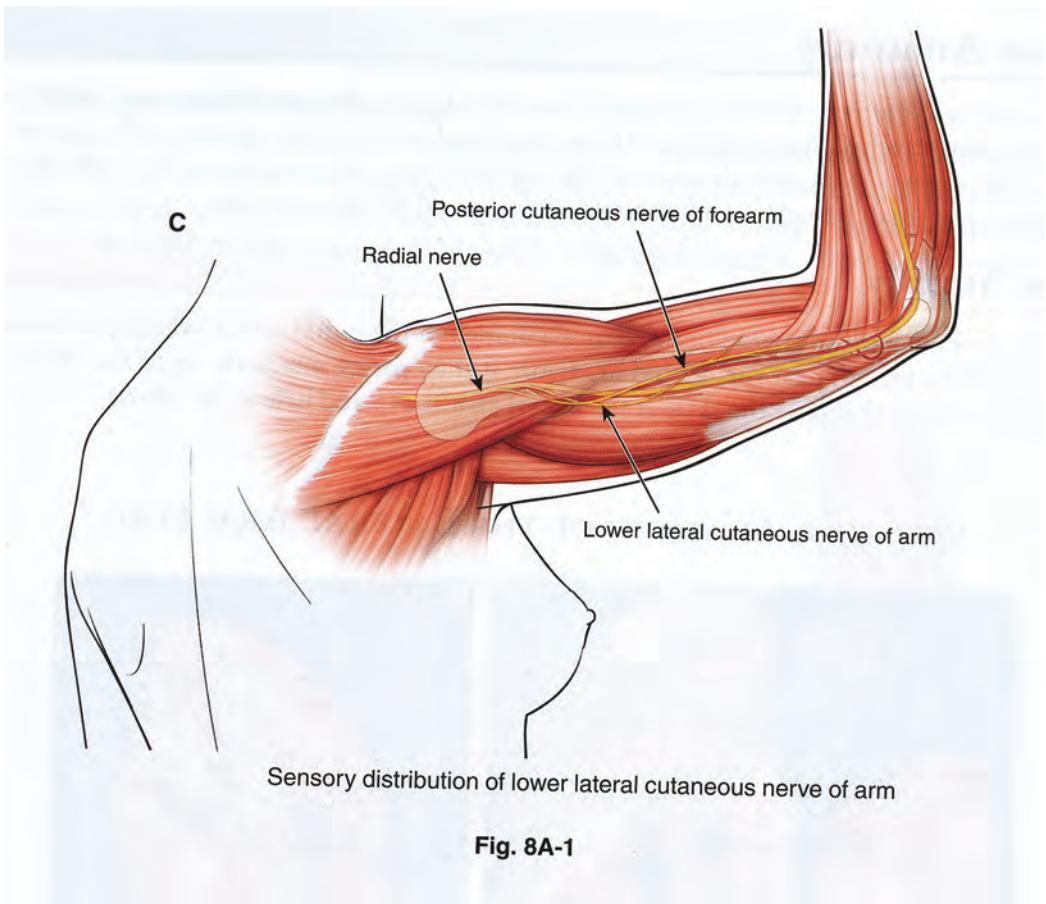
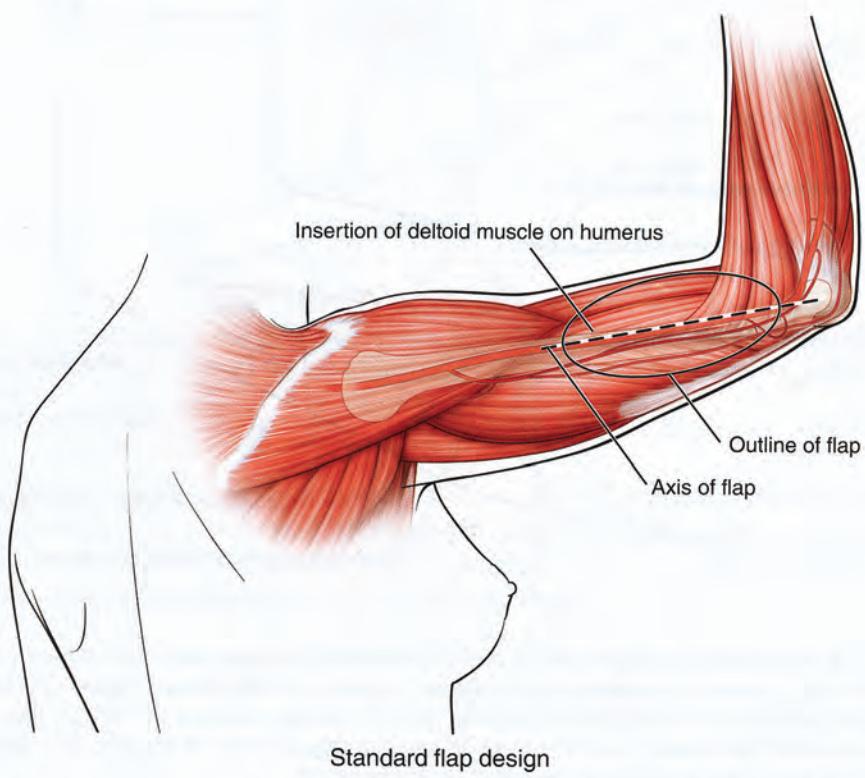


Fig. 8A-1

**Dominant pedicle:** Posterior radial collateral artery



**Fig. 8A-1**

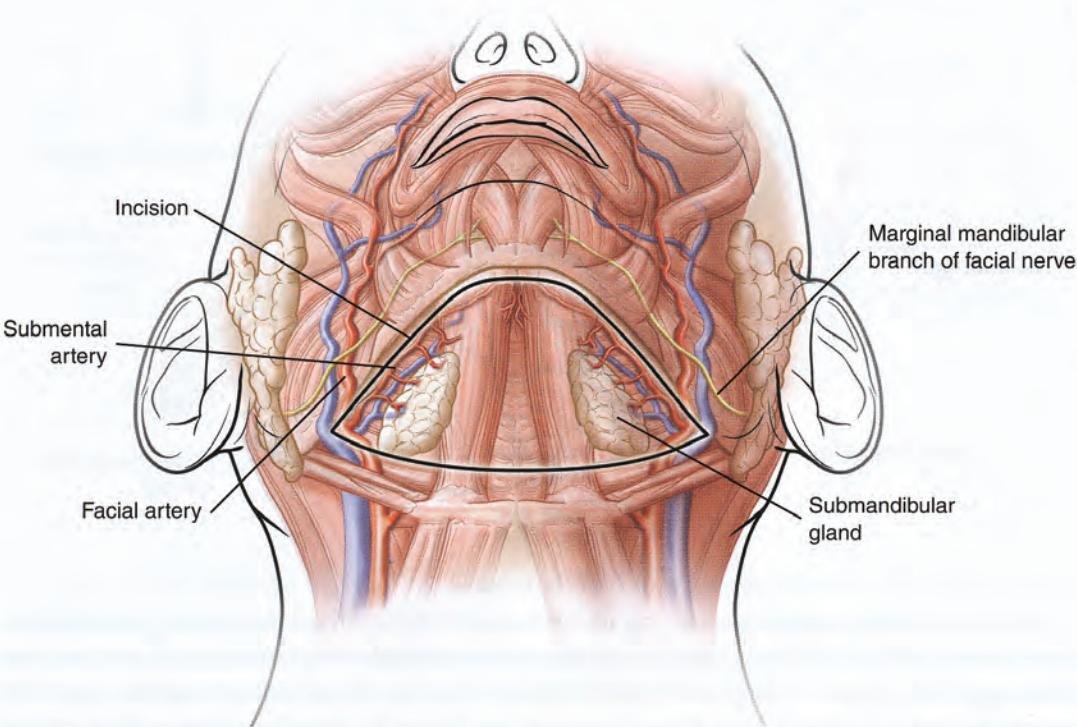


**Fig. 8A-3** With the patient either standing or supine, a line is drawn from the deltoid insertion to the lateral epicondyle of the humerus. This line represents the central axis of the flap. It also delineates the lateral intermuscular septum and the course of the PRCA.

## Flap: Submental Flap

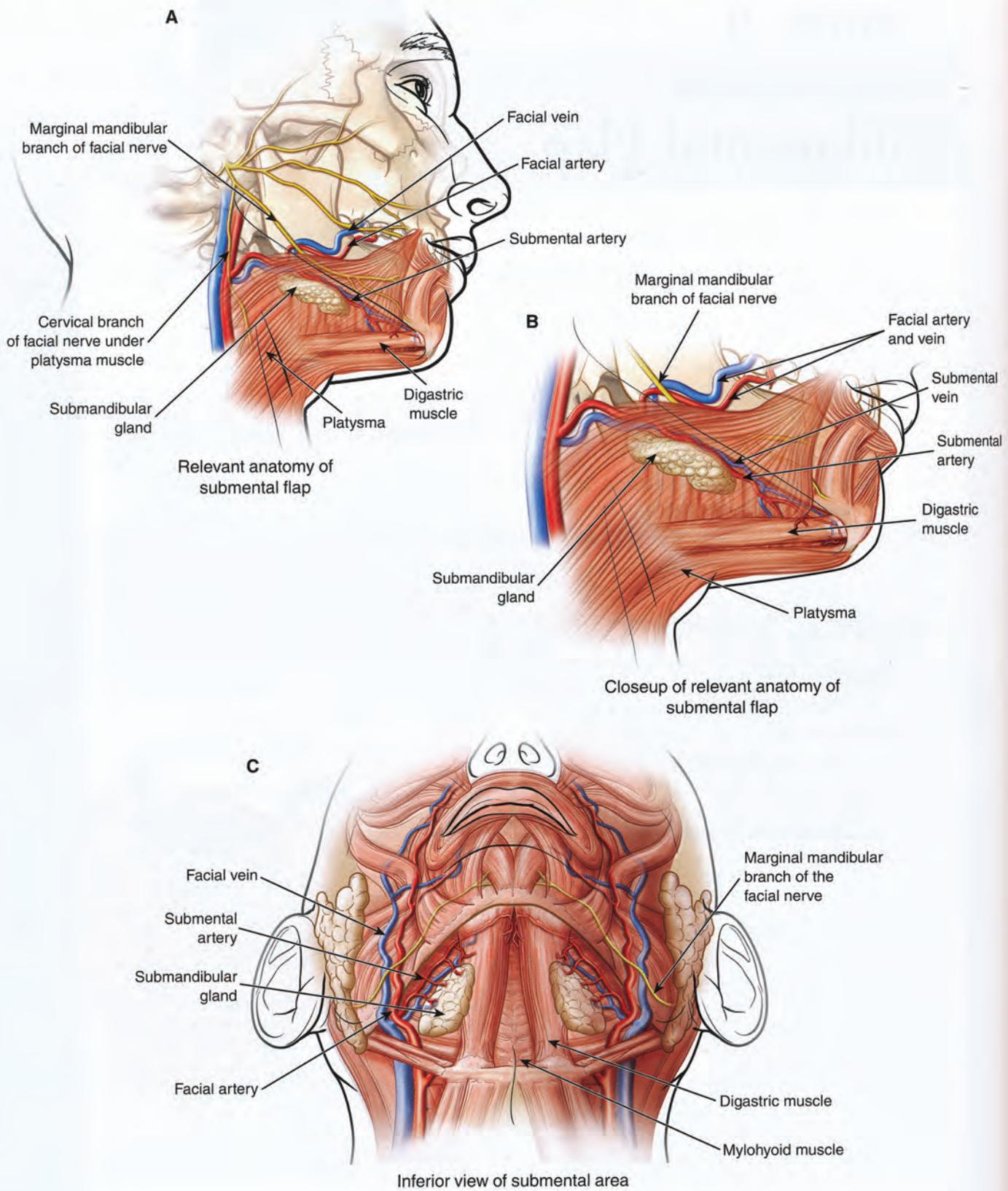
<b>Tissues available:</b>	cutaneous
<b>Vascular Anatomy:</b>	submental artery (1.0mm), branch of facial artery (2.5 mm); submental vein (1.5mm) and facial vein (2.3 mm); pedicle can be lengthened if based on reverse facial artery as a pedicle flap-extra micro may be needed for vein
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	7 x 18 cm
<b>Advantages:</b>	thin, pliable, good facial color match with hidden donor scar; hair bearing in men
<b>Disadvantages:</b>	hair bearing in men; may have been dissected in previous H & N surgery;
<b>Things to note:</b>	anterior digastric muscle should be included on ipsilateral side to include perforators on both sides of the muscle. Upper third of the face can be reached with lengthening of the pedicle. Planning important if flap is to be used in conjunction with a H & N case, especially if lymph node dissection planned. Can be used as a free flap as well.

### Notes:



**Fig. 5I-3** A line 1 cm posterior to the jawline is marked with the patient sitting. The width is determined by the pinch test. The design extends only to the mandibular angles.

### ANATOMY OF THE SUBMENTAL FLAP



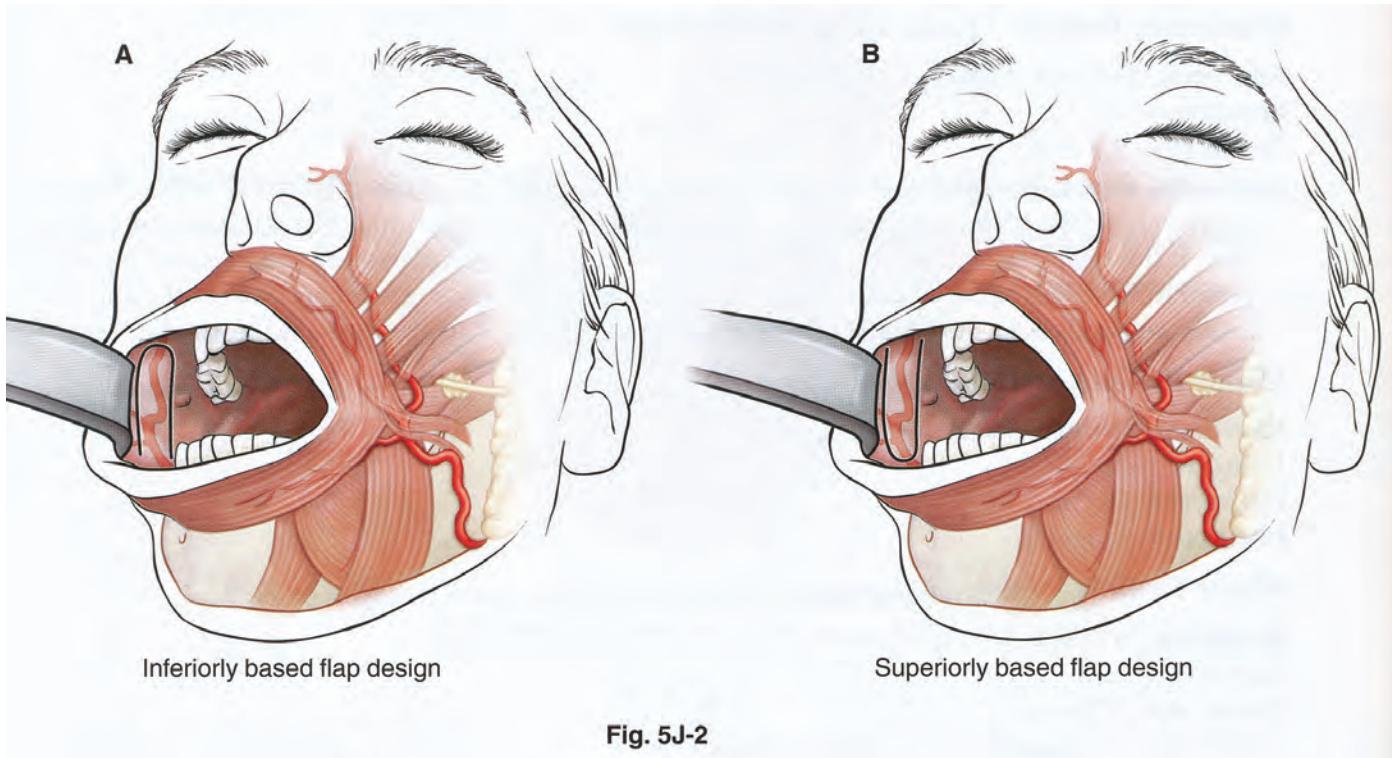
**Fig. 5I-1**

**Dominant pedicle:** Submental artery

## **Flap: Facial Artery Myomucosal (FAMM) Flap**

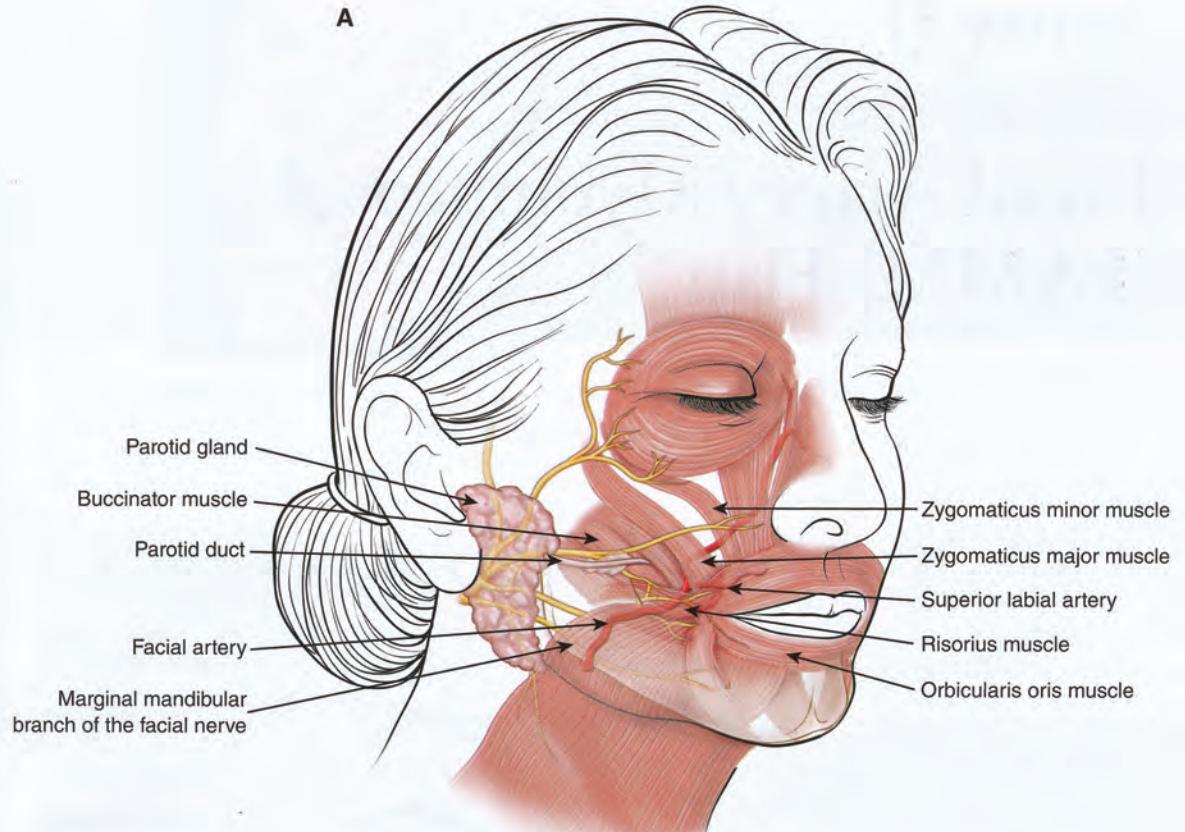
<b>Tissues available:</b>	myomucosal
<b>Vascular Anatomy:</b>	angular branch of facial artery and vein as pedicle flap; can be based superiorly (retrograde flow) or inferiorly depending on need
<b>Innervation:</b>	none
<b>Flap Dimensions:</b>	2 cm x 6 cm
<b>Advantages:</b>	thin, well vascularized source of mucosal lining; can reach lip, palate, and nose for lining depending on pedicle orientation
<b>Disadvantages:</b>	limited by primary closure and previous radiation; may require secondary division and inset
<b>Things to note:</b>	think of as a “reverse nasolabial flap” which includes the facial artery and a cuff of buccinator muscle for vascularity

**Notes:**

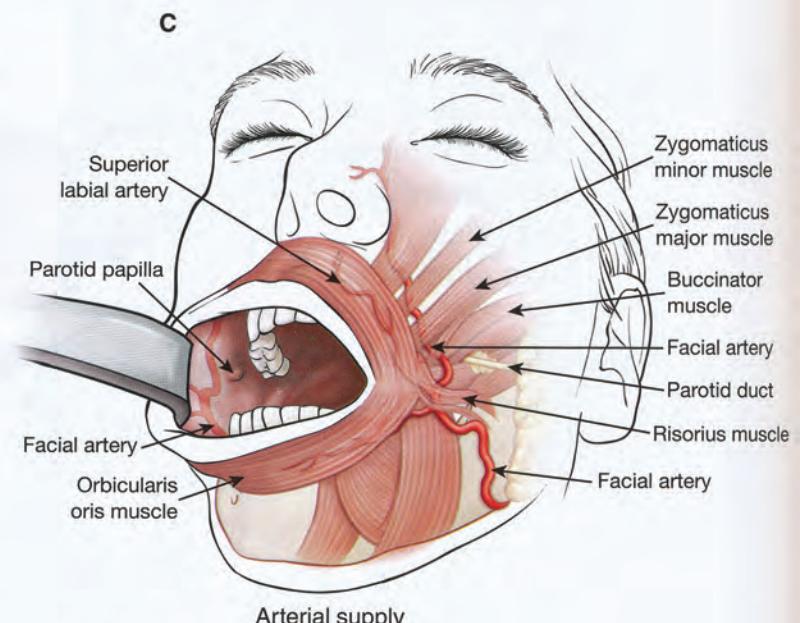
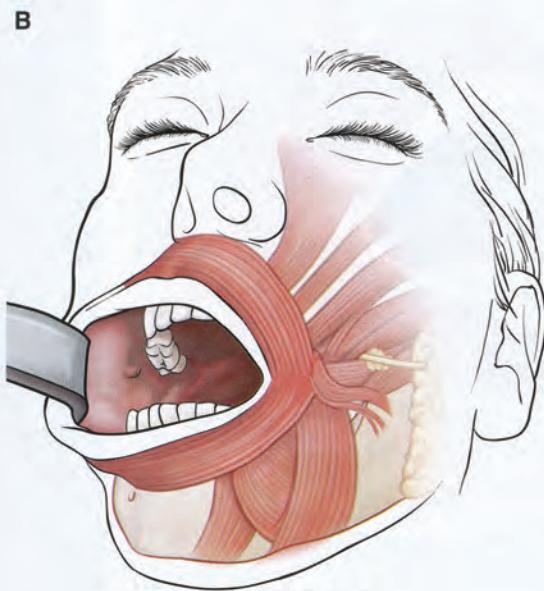


**Fig. 5J-2**

## ANATOMY OF THE FACIAL ARTERY MYOMUCOSAL (FAMM) FLAP



Anatomy relevant to FAMM flap showing course of facial artery and relationship to parotid duct and facial muscles



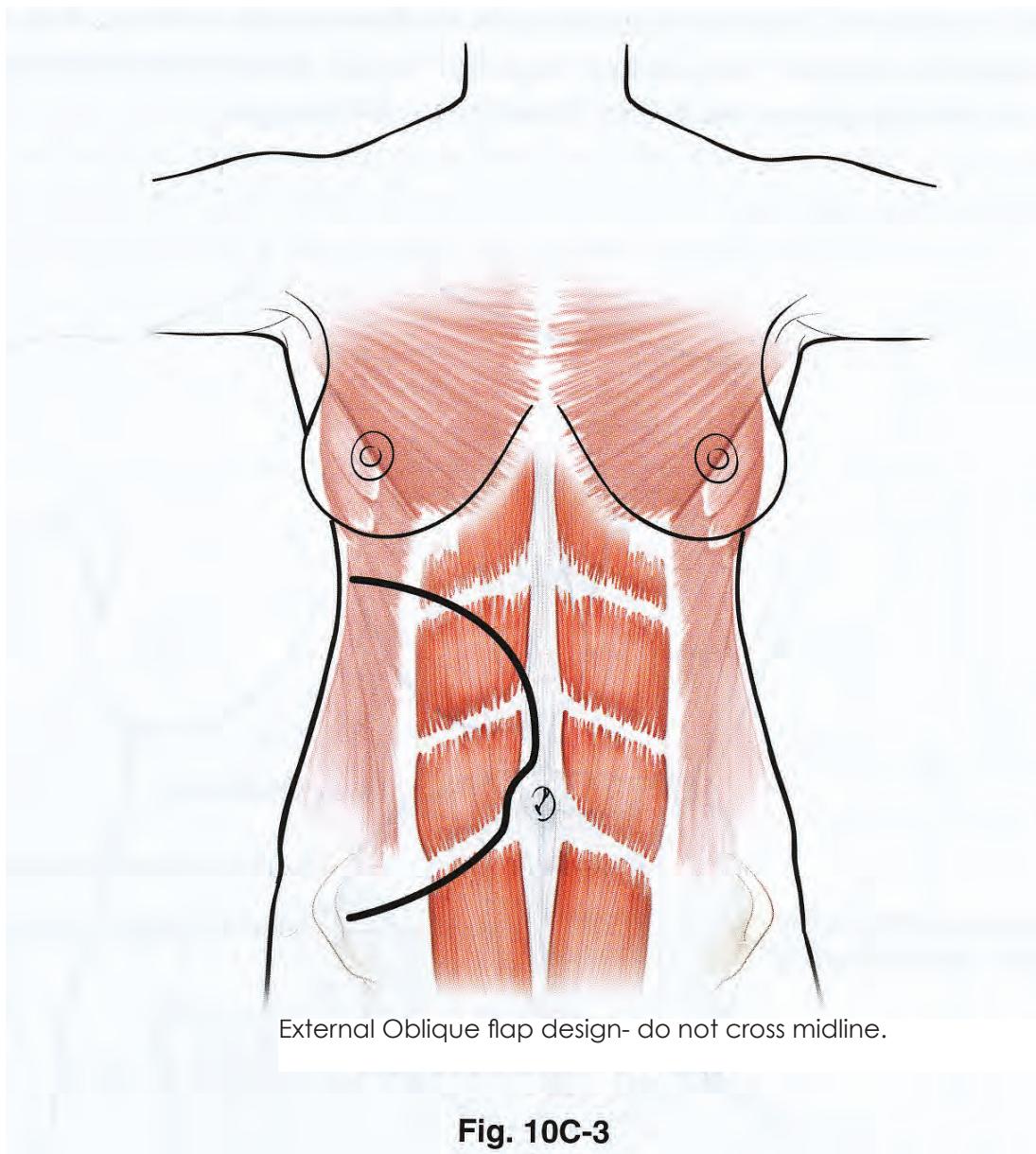
**Fig. 5J-1**

**Dominant pedicle:** Facial artery  
**Minor pedicle:** Superior labial artery

## **Flap: External Oblique Flap**

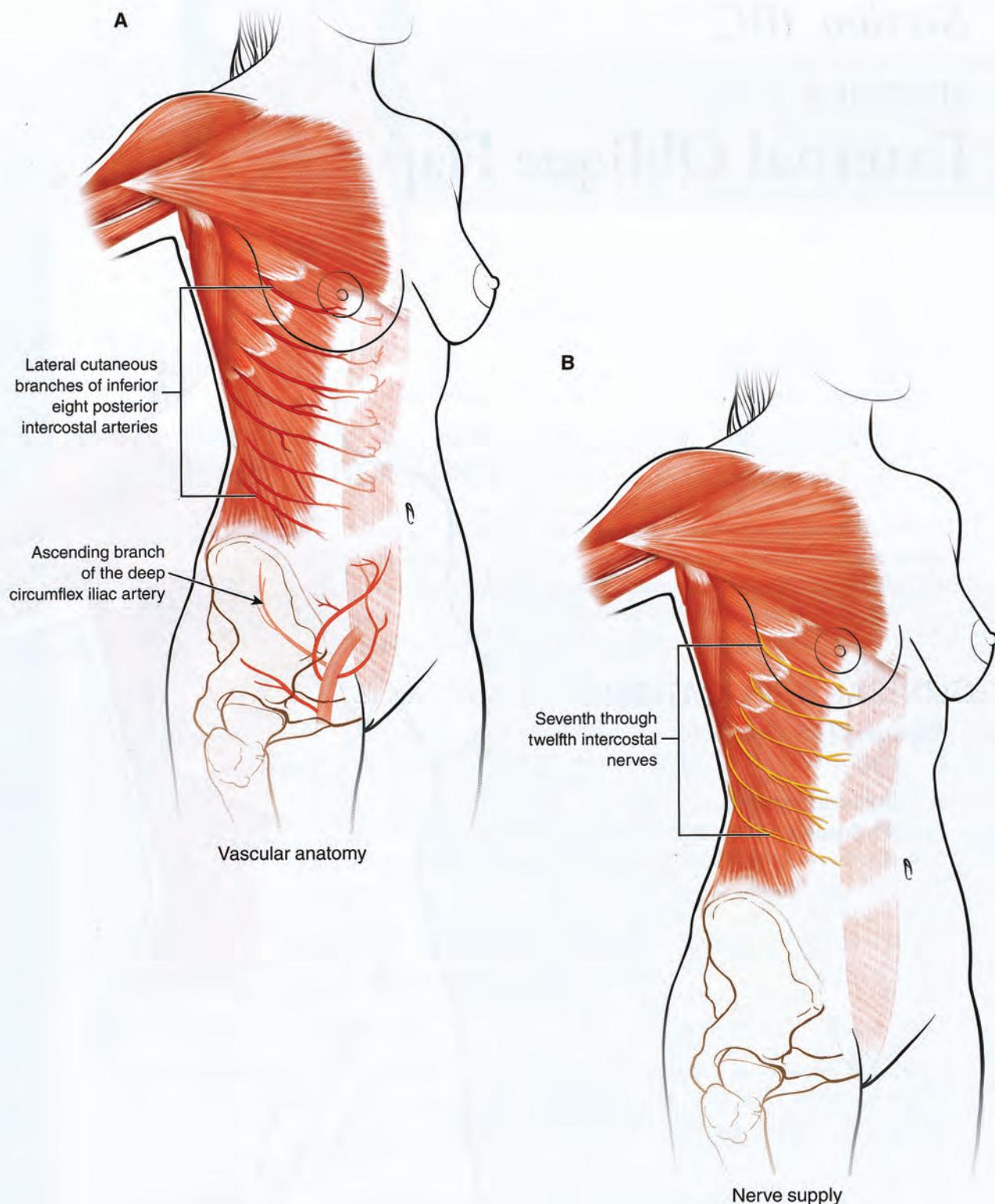
<b>Tissues available:</b>	skin, muscle, fascia
<b>Vascular Anatomy:</b>	posterior intercostals vessels (6 <sup>th</sup> to 12 <sup>th</sup> ); superficial circumflex iliac(inferior)
<b>Innervation:</b>	intercostals nerves (6 <sup>th</sup> to 12 <sup>th</sup> ), iliohypogastric
<b>Flap Dimensions:</b>	20 x 30 cm
<b>Advantages:</b>	often not in irradiated field for chest reconstruction; primary closure of donor; sensate; supine position for harvest; simple to elevate
<b>Disadvantages:</b>	potential for abdominal bulge
<b>Things to note:</b>	turnover flaps for back defects

Notes:



**Fig. 10C-3**

## ANATOMY OF THE EXTERNAL OBLIQUE FLAP



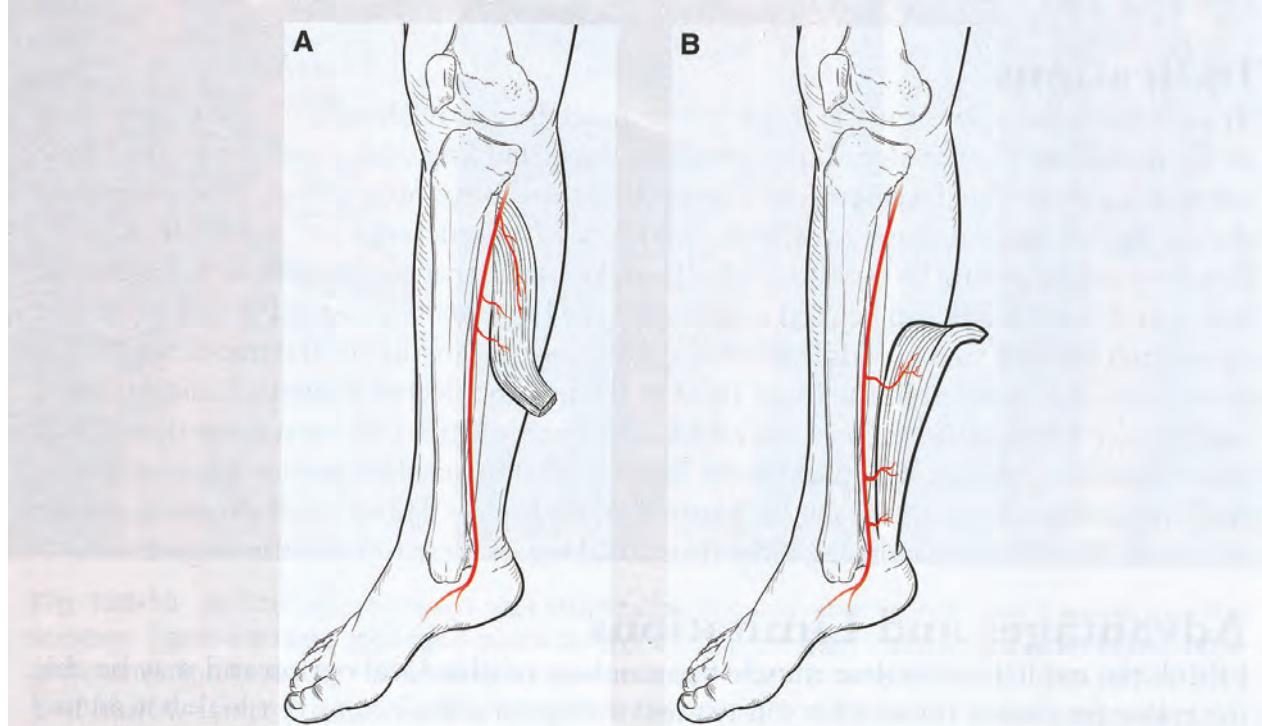
**Fig. 10C-1**

**Dominant segmental pedicle:** Lateral cutaneous branches of inferior eight posterior intercostal arteries  
**Minor pedicle:** Ascending branch of deep circumflex iliac artery

## Flap: Soleus Flap

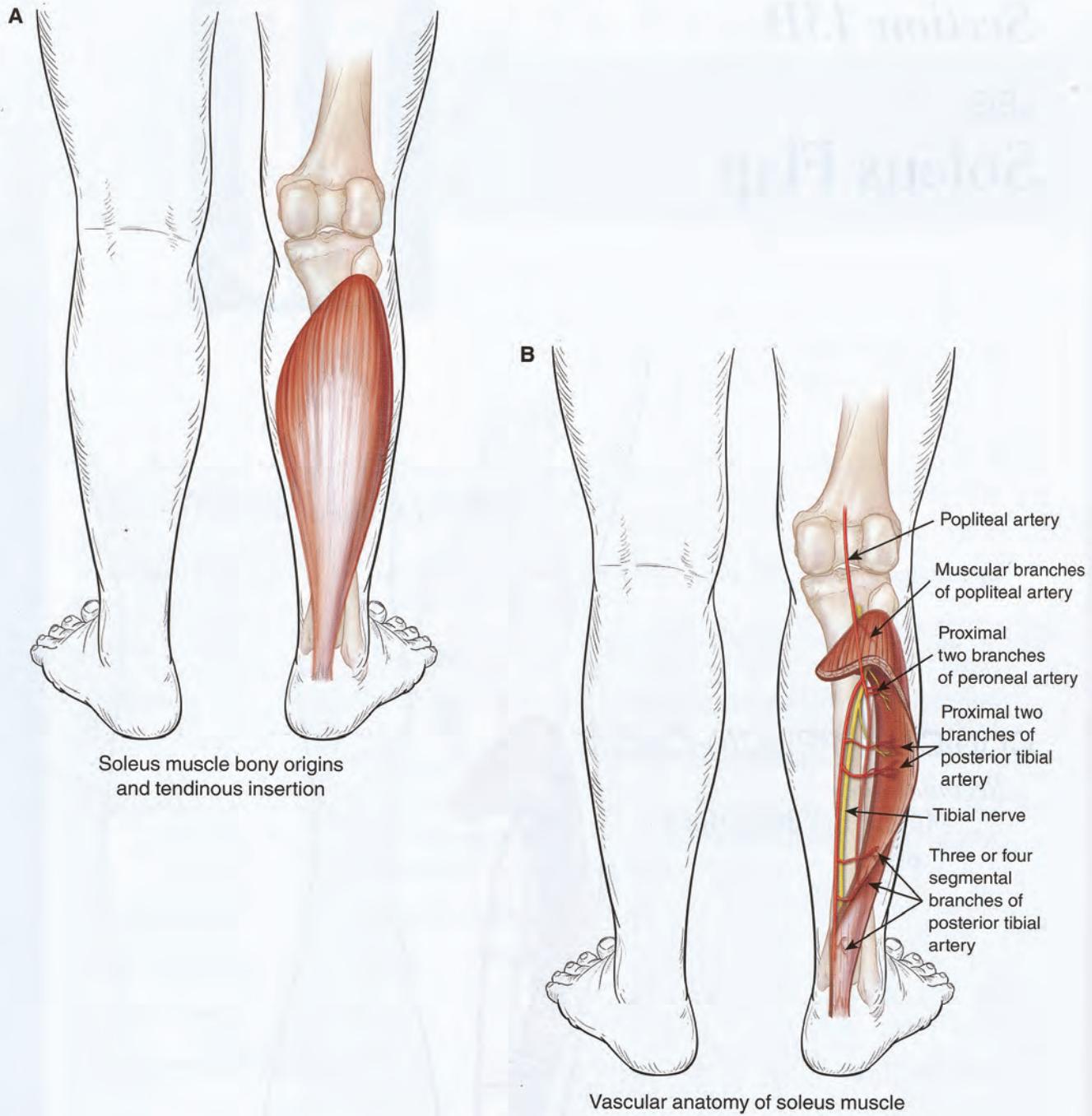
<b>Tissues available:</b>	muscle
<b>Vascular Anatomy:</b>	medial half: posterior tibial artery lateral half: peroneal artery
<b>Innervation:</b>	tibial nerve (motor)
<b>Flap Dimensions:</b>	7 x 10 cm
<b>Advantages:</b>	simple elevation, minimal morbidity
<b>Disadvantages:</b>	in the “zone of injury” in trauma cases and may not be reliable; need a skin graft
<b>Things to note:</b>	“reversed” flap based on distal posterior tibial perforators unreliable; can use half of the soleus (hemisoleous) and combine with one head of the gastrocnemius to cover large defects without function problem

Notes:



**Fig. 13B-11** **A**, Flap dissection and blood supply to the proximally based medial hemisoleus muscle flap. The flap is based proximally and receives blood supply primarily from the posterior tibial vessels. The flap also receives additional blood supply from one or two distal perforators of the posterior tibial vessels to its distal portion. **B**, Flap dissection and blood supply to the distally based medial hemisoleus muscle flap. The flap is based distally and receives blood supply primarily from the most distal two or three perforators of the posterior tibial vessels.

## ANATOMY OF THE SOLEUS FLAP



**Fig. 13B-1**

**Dominant pedicles:** Muscular branches of popliteal artery; proximal two branches of peroneal artery; proximal two branches of posterior tibial artery

**Minor pedicle:** Three or four segmental branches of the posterior tibial artery

## **Flap: Deep Circumflex Iliac Artery (DCIA) Flap**

**Tissues available:** bone, skin, muscle

**Vascular Anatomy:** deep circumflex iliac artery(2.8mm) and vein (3.6mm)  
pedicle length 4 – 6 cm

**Innervation:** none

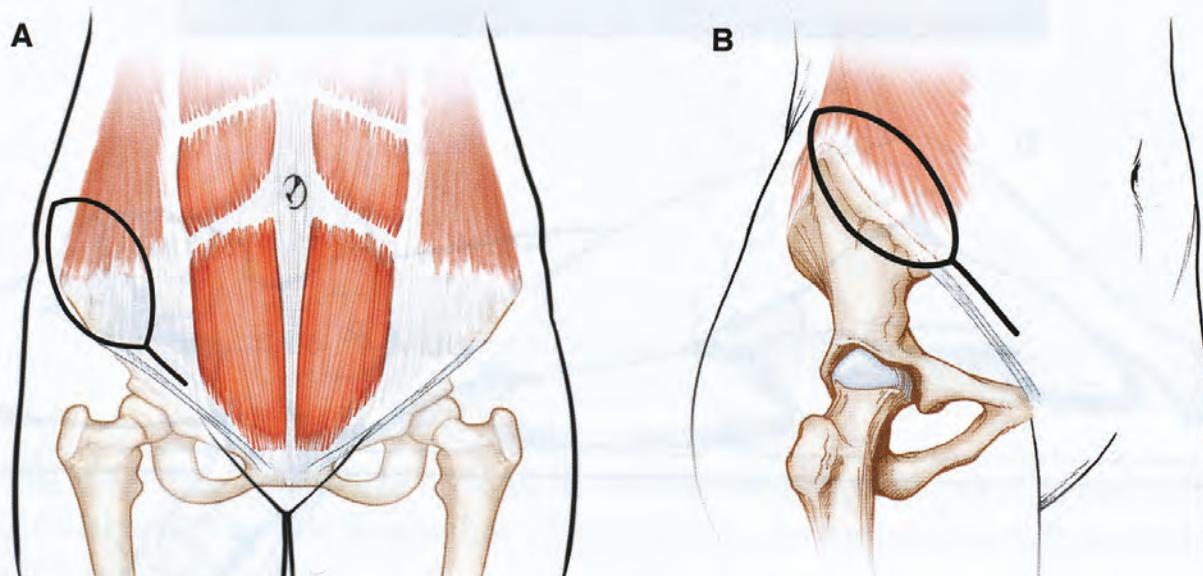
**Flap Dimensions:** bone: 4 x 12 cm  
skin: 8 x 20 cm

**Advantages:** concealed donor site scar

**Disadvantages:** abdominal hernia possible; bulky flap; bone defects limited to 12 cm; lateral cutaneous nerve numbness possible;

**Things to note:** ipsilateral iliac crest for mandibular reconstruction; can harvest internal oblique muscle as chimeric flap

**Notes:**



**Fig. 10A-3**

ANATOMY OF THE DEEP CIRCUMFLEX ILIAC ARTERY (DCIA) FLAP

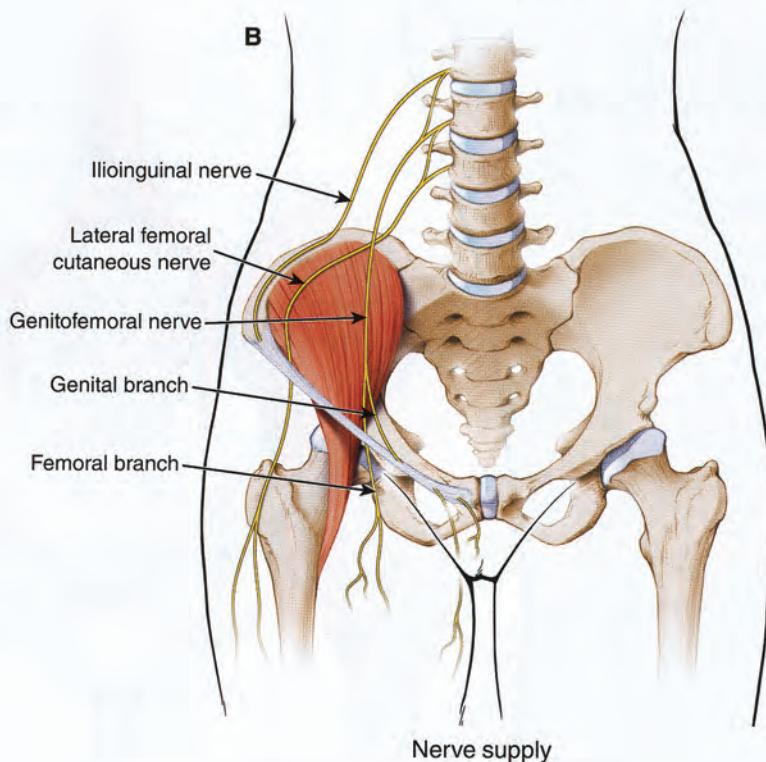
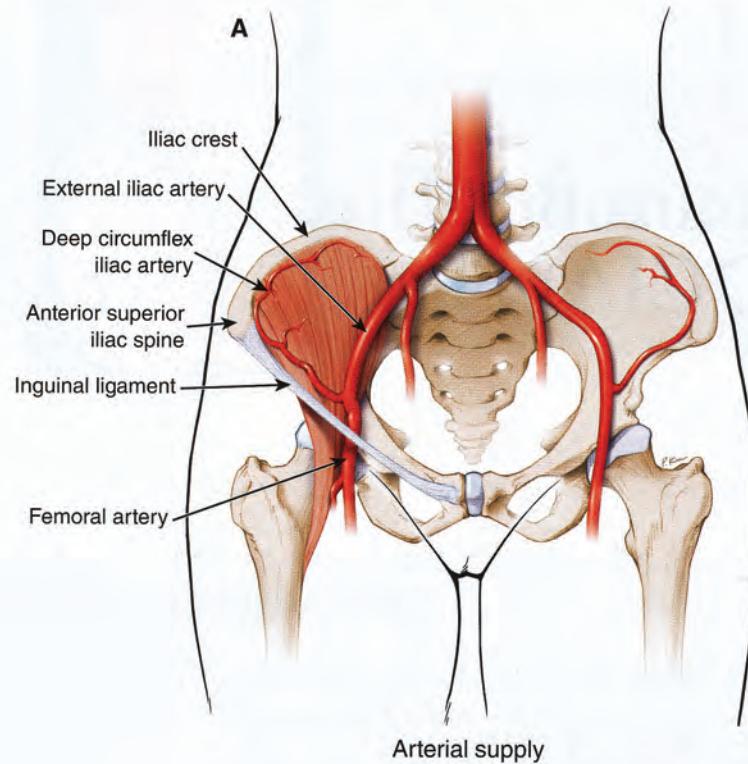


Fig. 10A-1

**Dominant pedicle:** Deep circumflex iliac artery

## Flap: Cross Finger Flap

**Tissues available:** skin, adipofascial

**Vascular Anatomy:** no pedicle

**Innervation:** no pedicle

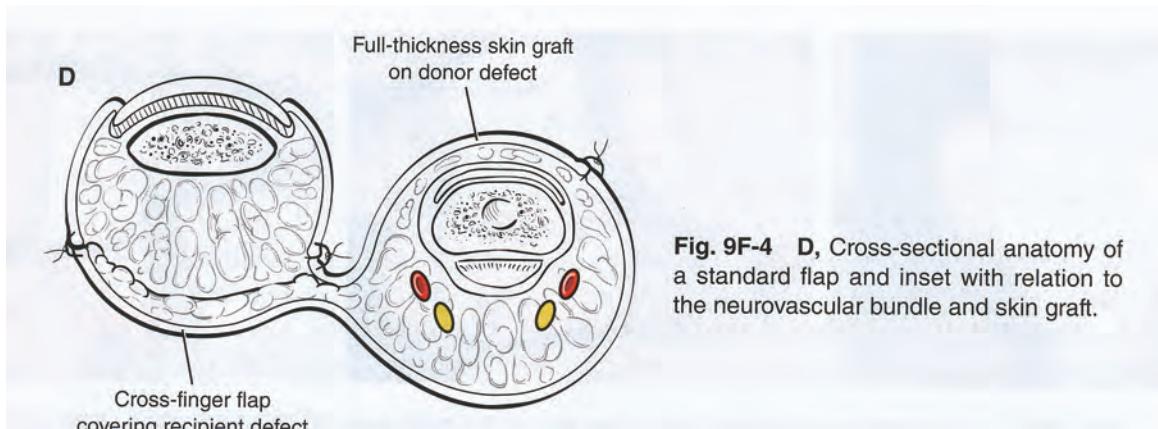
**Flap Dimensions:** 2.5 x 2 cm

**Advantages:** simple, reliable; good for extensor or flexor tendon coverage

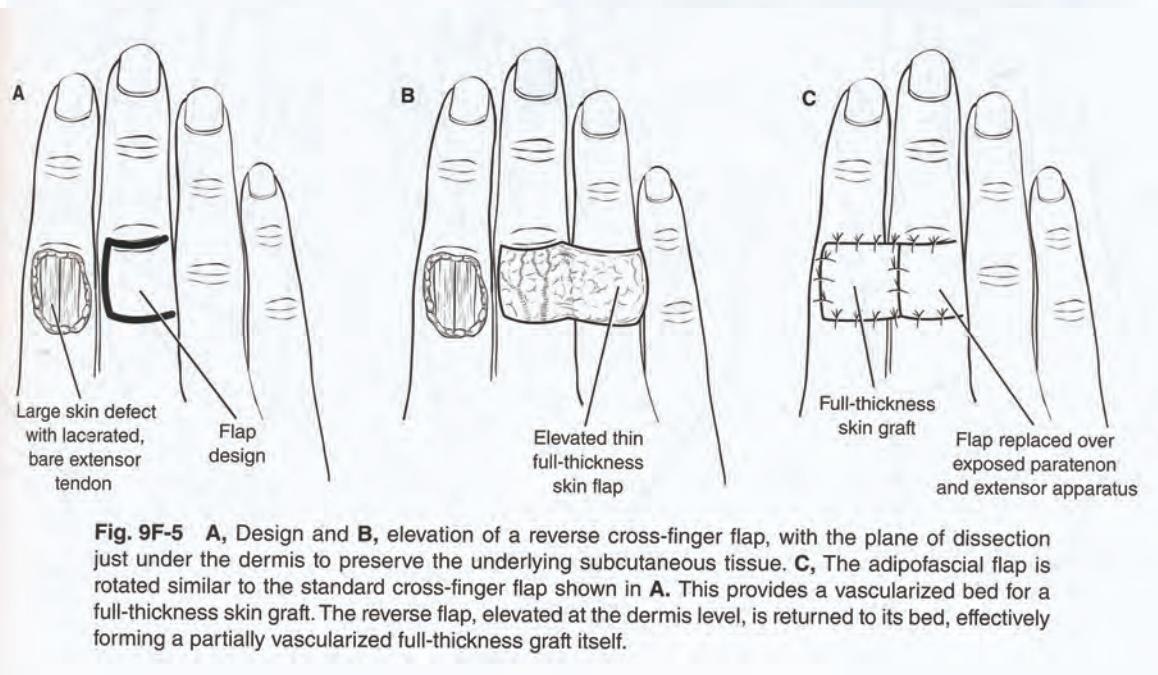
**Disadvantages:** limited size; requires second surgery to divide; skin graft of donor may be conspicuous

**Things to note:** preserve donor paratenon for skin graft to take; can include axial pedicle; middle finger donor preferred

**Notes:**



**Fig. 9F-4 D**, Cross-sectional anatomy of a standard flap and inset with relation to the neurovascular bundle and skin graft.



## **Flap: Adductor Digiti Minimi (ADM) Flap**

**Tissues available:** muscle

**Vascular Anatomy:** lateral plantar artery

**Innervation:** none (sensory)

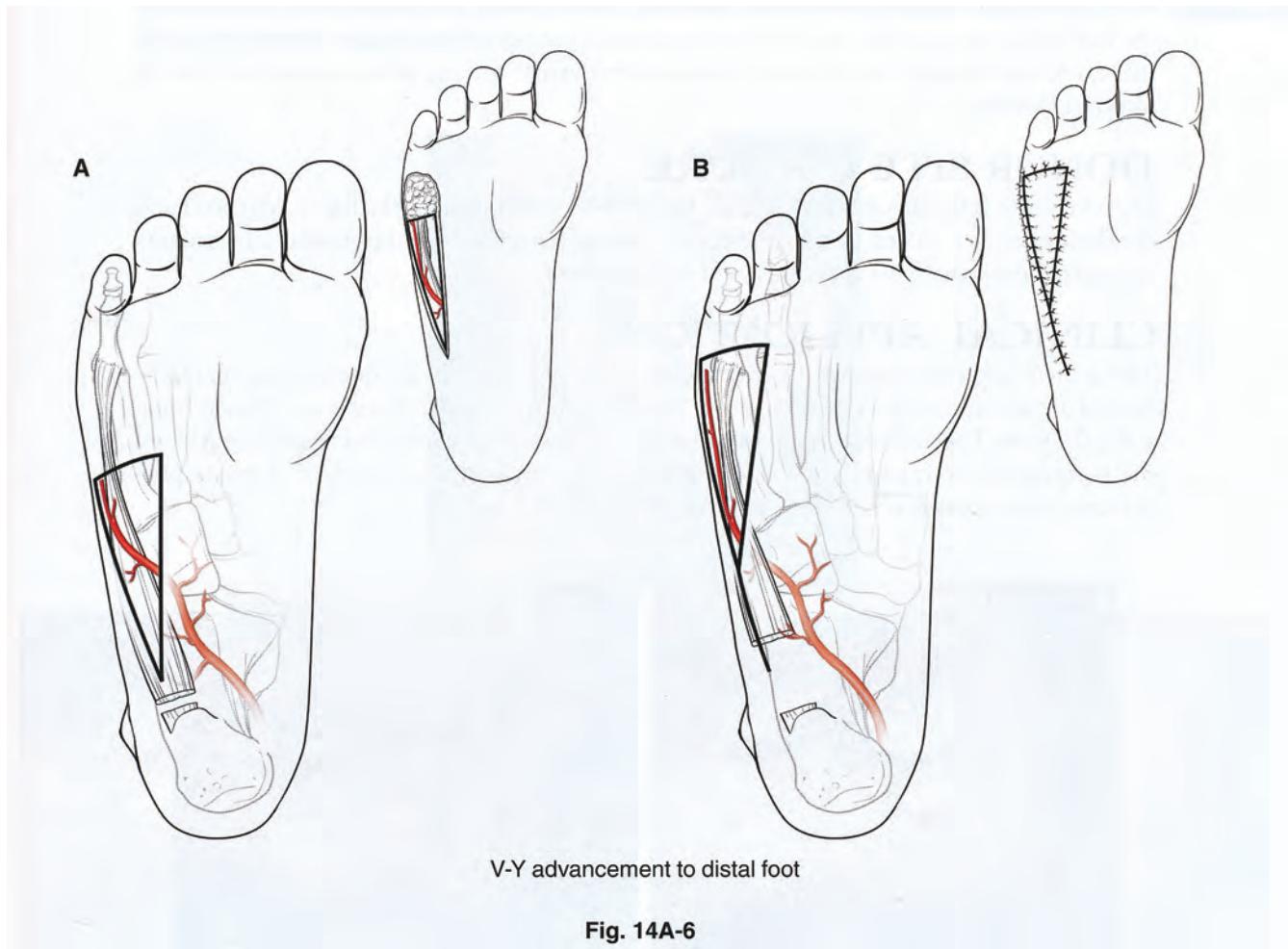
**Flap Dimensions:** 4 to 5 cm

**Advantages:** soft tissue coverage of the lateral malleolus and distal

**Disadvantages:** small size, short arc of rotation

**Things to note:** distal division of the lateral plantar artery provides greater arc of rotation

**Notes:**



**Fig. 14A-6**

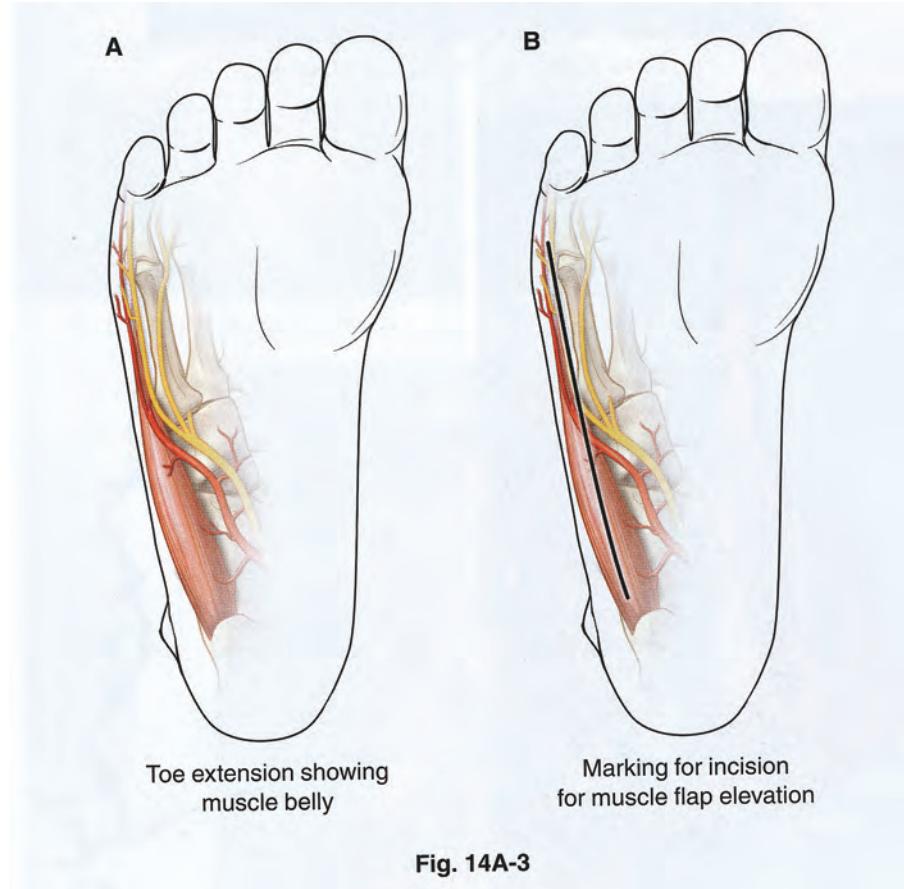


Fig. 14A-3

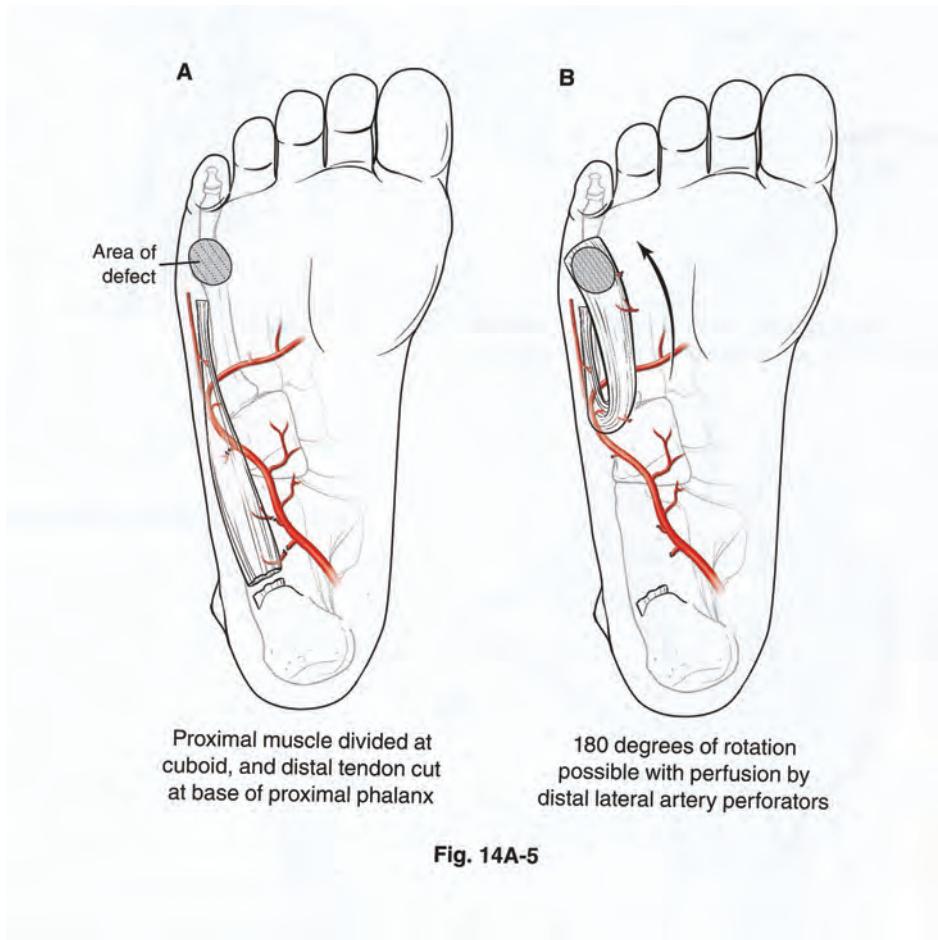
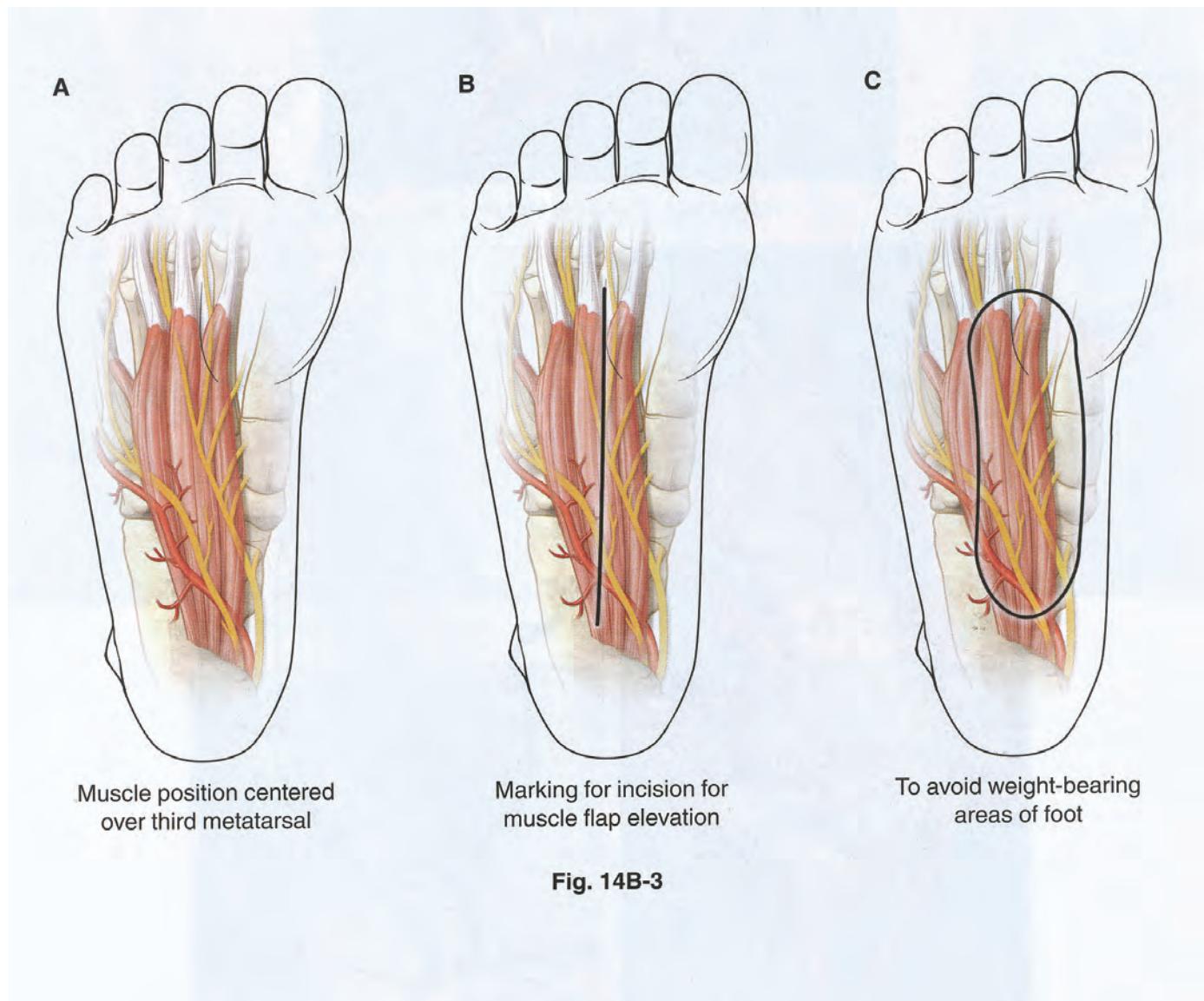


Fig. 14A-5

### **Flap: Flexor Digitorum Brevis (FDB) Flap**

<b>Tissues available:</b>	muscle or as part of fasciocutaneous plantar flap
<b>Vascular Anatomy:</b>	lateral plantar artery
<b>Innervation:</b>	medial plantar nerve (motor)
<b>Flap Dimensions:</b>	8 to 10 cm
<b>Advantages:</b>	soft tissue coverage of the heel, sole of the foot, or Achilles tendon
<b>Disadvantages:</b>	short arc of rotation
<b>Things to note:</b>	dividing origin allows 1 cm more of reach

Notes:



**Fig. 14B-3**

## Flap: Abductor Hallucis Flap

**Tissues available:** muscle

**Vascular Anatomy:** medial plantar artery

**Innervation:** none

**Flap Dimensions:** 8 to 12 cm

**Advantages:** soft tissue coverage of the medial aspect of the heel

**Disadvantages:** short arc of rotation, tendinous distal end of flap

**Things to note:** avoid tendon of flexor hallucis brevis

**Notes:**

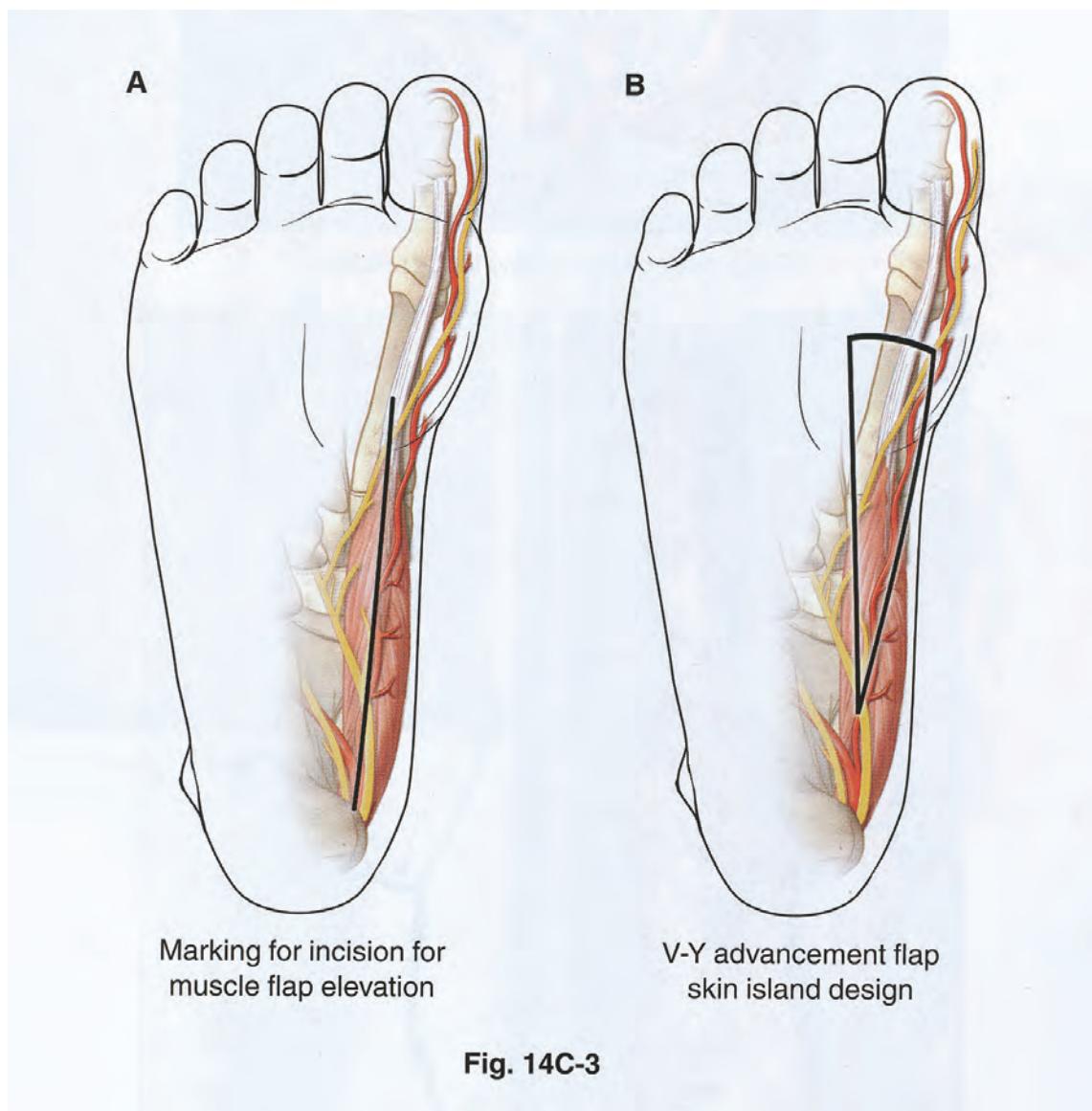


Fig. 14C-3