

Latissimus Dorsi Flap

Richard Davis, Geoffrey Hallock, Yoko Young Sang

Introduction:

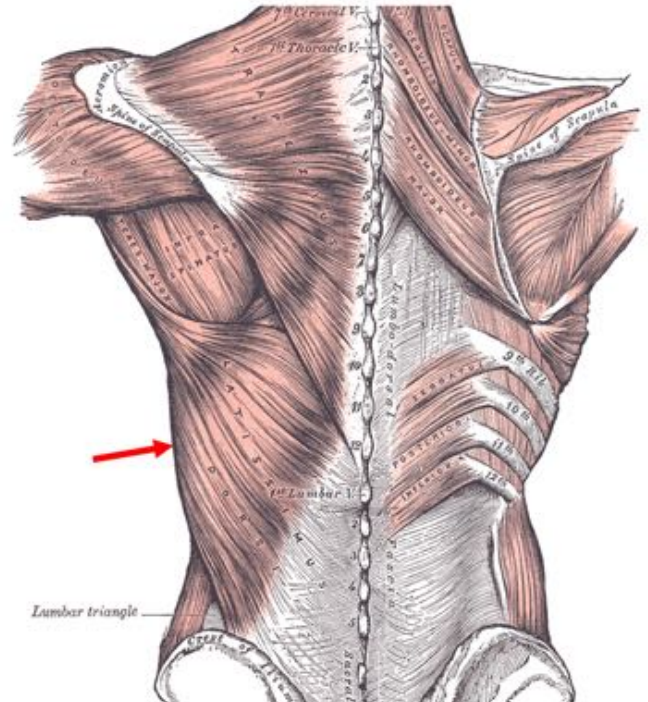
The Latissimus Dorsi (LD) flap is a versatile muscular or musculocutaneous flap that can be used to cover defects in a wide area that spans the anterior chest, axilla, shoulder, anterior and lateral neck, thoracic spine, and even the oral cavity and oropharynx. It is robust, meaning that it can successfully be used by “occasional” plastic surgeons. Its primary neurovascular pedicle is easy to find and to preserve during harvest.

The LD is a fan-shaped muscle about 30 cm in length, originating from the spinous processes of T7-L5 vertebrae, the 7th to 12th ribs, and the posterior superior iliac spine. It inserts on the medial aspect of the head of the humerus, between the insertions of the teres major and pectoralis major muscles. It functions to adduct and internally rotate the upper arm, as well as to support the trunk. In its absence arm adduction is weakened and the back symmetry is lost. Its primary vascular supply is the thoracodorsal artery and vein, which originate off the 3rd portion of the subclavian vessels. Its nerve supply is the thoracodorsal nerve, which runs with the artery and vein.

The standard LD flap is created by detaching the fan-shaped portion of the muscle from the chest wall, often including some of the overlying skin. When completely detached up to the axilla, it can provide soft tissue coverage in a range up to about 30cm from the head of the humerus. This area encompasses the upper arm, axilla, breast and anterior chest wall, anterior and lateral neck, and even the floor of mouth, cheek, or oropharynx.

Although the LD flap will easily reach the oral cavity and even the temporal region or skull base, it is not commonly used in head and neck reconstruction. This is because the volume of muscle adds bulk wherever it is placed, and there are other easier and less morbid flap options in the head and neck, described elsewhere in this Manual.

The LD flap is most commonly used for reconstruction of chest wall defects, reconstruction after mastectomy, and closure of defects on the anterior or lateral neck if a large amount of tissue is needed. This flap can be transferred with muscle alone, without a skin paddle.



The latissimus dorsi (Red Arrow) is a long, flat, fan-shaped muscle which can be rotated around the axis of its thoracodorsal vascular pedicle, with or without division of the muscle near to its insertion on the humerus.



For deeply scarred burn contractures, a musculocutaneous flap provides a superior result compared to a full thickness skin graft. Additionally, a neck brace is not required during healing, as it would be with a skin graft to prevent a recurrence of the contracture.

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For breast reconstruction, a breast tumor that cannot be closed primarily after mastectomy should be treated with neoadjuvant chemotherapy. LD flap closure is reserved for those tumors which remain too large for primary closure after chemotherapy, or for debulking of tumors that do not respond to chemotherapy at all. The surgeon should be careful to assess the axilla, as a high lymph node burden will make harvesting this flap impossible. Decision-making is discussed further in the “Malignant Breast Disease” Section.



This patient underwent neoadjuvant chemotherapy for locally invasive breast cancer. The tumor responded to treatment, but a mastectomy would still leave a wound that is too large to close. A skin graft is another option, but would be much worse cosmetically.

The main disadvantage of the LD flap is that it requires the lateral decubitus position to harvest. (See [Lateral Decubitus Position](#).) When it is used to cover a defect in the anterior chest wall or neck, the patient must often be repositioned. In most situations, the tumor is first removed in supine position, the defect is measured, and then the patient is placed in the lateral decubitus position and the surgeon harvests the flap. Harvesting a flap that is too large or too small has disadvantages at both the donor and recipient sites. This has several implications:

- For breast cancer, mastectomy can first be done in the supine position (with or without axillary dissection.). The patient is then placed in the lateral decubitus position, the

flap is harvested, and the mastectomy defect is closed with the flap in this position.

- For anterior neck contracture release, even an experienced surgeon will have difficulty predicting the size of the defect before releasing it. The safest option is to release the contracture and measure the defect in the supine position, then harvest the flap in the lateral decubitus position, then return the patient to supine position to close the defect.
- For closure of floor of mouth or neck defects after cancer resection, the same principles may apply: the resection is done in supine position, the flap is harvested in lateral decubitus position, then the defect is closed with the patient back in supine position.

The steps of the LD flap creation and placement are as follows:

- The defect is created (tumor resection, contracture release) and measured.
- The patient is placed in the lateral decubitus position.
- The flap is carefully measured, being sure that the point of rotation will allow it to reach the defect, especially if a skin paddle will be included, as described here.
- Incisions including a skin paddle are made
- The muscle is dissected off of the surrounding skin and chest wall
- The flap is rotated into place or moved into a position where it can be retrieved.
- The skin of the harvest site is closed.
- The patient is repositioned if necessary and the flap is placed and sutured into the defect.

Steps:

1. Careful examination in the clinic, with the patient unclothed, allows the surgeon to visualize the anterior crease of the LD muscle and assess whether its most inferior extent can reach the planned defect. The axilla should be examined carefully, as axillary adenopathy will make complete mobilization of the flap very difficult or impossible.

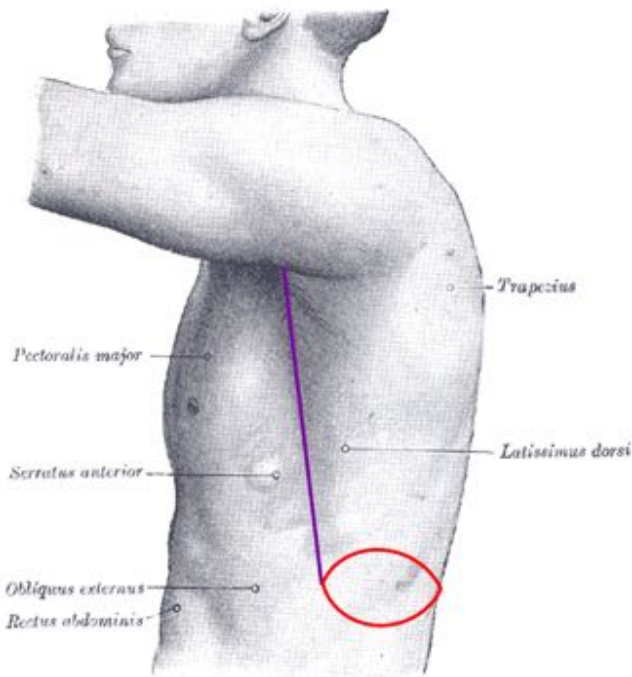
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Palpation and grasping of the posterior axillary fold allows the surgeon to feel the LD muscle. Patient is in right lateral decubitus position, head towards the top and facing toward the left side of the photo. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

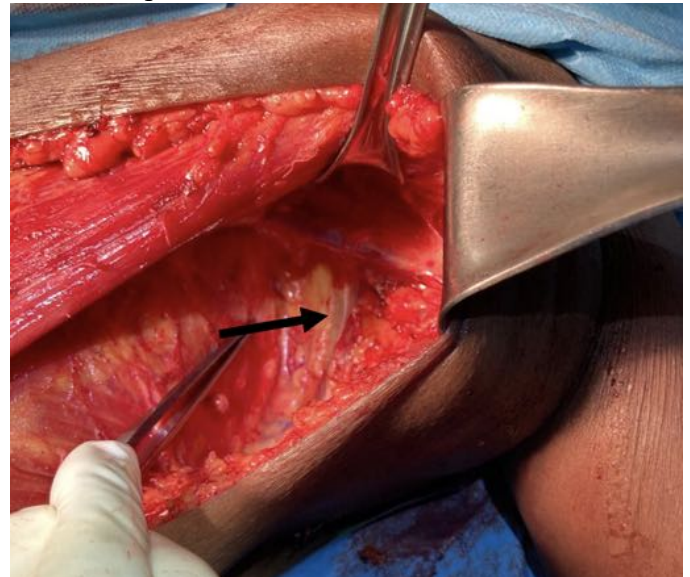
2. The patient should be explained that they will have weakness of shoulder adduction and an asymmetrical appearance of the back after harvest of the LD.



With the patient in the seated position, the anterior border of the LD (Purple Line) can be marked. The anticipated distance from the axilla to the defect can be used to position the skin paddle (in Red)

3. General anesthesia is induced. Avoid IV cannula placement in the ipsilateral arm.

4. The patient is positioned for tumor resection, contracture release, debridement or other creation of the soft tissue defect.
5. If performing a mastectomy and axillary dissection, take care to identify and preserve the thoracodorsal neurovascular bundle during the dissection (See Chapter, Axillary Dissection.) You can later follow this vessel caudally and identify where it enters into the latissimus dorsi muscle, supplementing the identification technique that is described below.



The thoracodorsal neurovascular bundle, shown here during left axillary dissection, runs deep to the latissimus dorsi, consistently about 1-2cm medial to its anterior edge. It is large and easy to identify up in the axilla.

6. Depending on the operation, it may be possible to harvest the latissimus dorsi flap first, or to place it while the patient is in the lateral decubitus position. This approach allows only one position change during the operation. Alternatively, it may be necessary to change the patient's position twice.

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Right axillary burn scar contracture after release and closure with a LD flap. As this defect was in the axilla, all of the steps of the operation could be done in the left lateral decubitus position. The skin paddle originated from healthy skin on the back caudal to the burn. The defect where the paddle originated is now the horizontal component of the wound closure (Black arrow.)

7. Measure the defect in horizontal and vertical dimensions.



Anterior neck contracture after release. The horizontal (Blue line) and vertical (Purple line) dimensions of the defect are measured and recorded. In this case, the neck has been extended to make sure that the space is completely filled by the skin paddle. Note that the patient must be in supine position for this release.

8. The distance from the posterior aspect of the axilla to the most lateral aspect of the defect is measured.



Measuring the distance from the axilla to the closest edge of the defect. A gentle curve is included to allow the flap to pass around, rather than directly anterior to, the shoulder.

9. A temporary dressing is placed over the defect.
10. The patient is placed in lateral decubitus position.
11. The anterior border of the LD is palpated and marked. A point 10cm below the axilla is also marked, indicating the location where the thoracodorsal vessels enter the muscle.



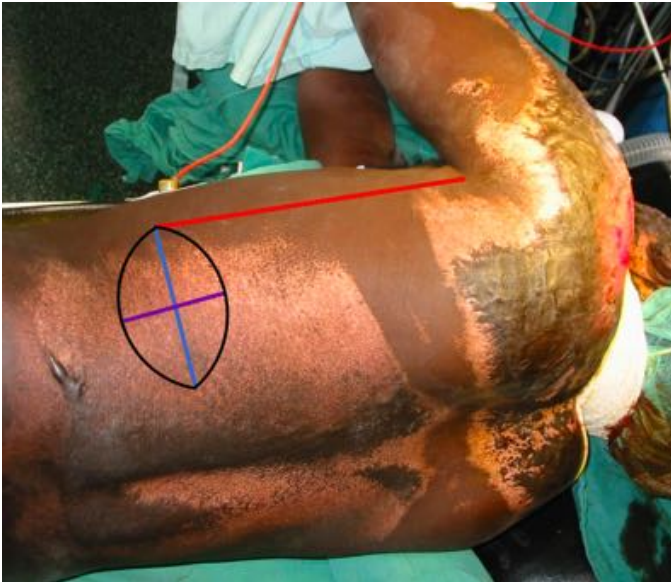
Left side of the chest, seen from the patient's front, showing the anterior border of the latissimus dorsi muscle and a point 10cm below the axilla and posterior to the border of the muscle, where the thoracodorsal vessels enter the muscle. During the surgery, the surgeon will make note of this location when dissecting deep to the muscle and watch out for the vessel, as described further below. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

12. A skin paddle matching the dimensions measured in step #8 is drawn. The orientation is considered such that when the muscle flap is rotated into place, the skin paddle will match the defect. All of the skin paddle should lie well above LD muscle, a few cm posterior to its anterior border. If a sterile pen is not available,

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light scratches with a sterile needle can be used to mark the measurements.



The distance from the axilla to the defect (Red line,) taken in Step #8, is measured from the axilla along the anterior border of the latissimus dorsi. The skin paddle is then positioned so that it is over muscle.



Grasping the skin in the area where the skin paddle is planned: it is loosest when grasped transversely as shown. A defect that remains after this skin is removed will be likely to close. For these photos, the patient's head is to the left of the photo and they are facing towards the bottom of the photo. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>



Mark the planned skin paddle relative to the latissimus dorsi muscle (dotted line.) Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

13. Incise the anterior skin paddle, superiorly and inferiorly, to allow you to find the latissimus dorsi muscle. Making this incision first allows the surgeon to locate the LD muscle relative to the flap, and to visualize exactly how far caudally the muscle extends. The paddle can still be repositioned if necessary, as only part of it has been incised.



Incision of the anterior portion of the planned skin paddle. This will be carried down to the latissimus dorsi muscle. As you dissect through the subcutaneous fat, taper incision away from the skin paddle, rather than making it straight downwards. If necessary, the paddle can still be trimmed or re-shaped at this point depending on the muscle underneath. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

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thoracodorsal vessels into the muscle, will allow easier dissection of the LD muscle off of the surrounding skin and deeper muscles of the chest wall. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>



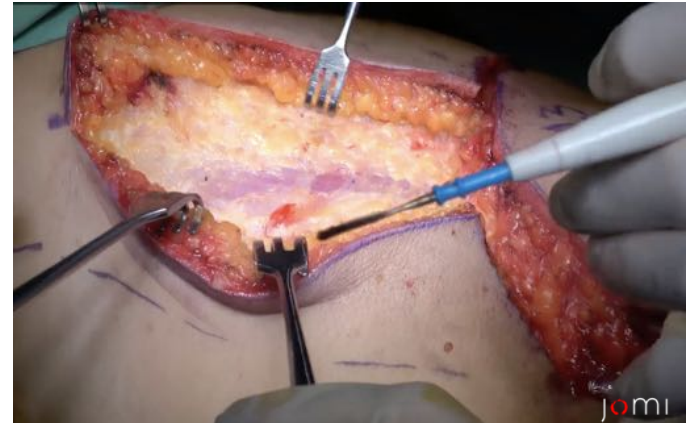
In the base of the incision, the transversely oriented fibers of the latissimus dorsi muscle are seen. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

14. Further dissect out the anterior border of the latissimus dorsi muscle, confirming that the skin paddle will lie completely on top of the muscle. Once you are satisfied that this is the case, make an incision proximally along the muscle. In this case, it is shown over the body of the muscle, extending from the previously measured point 10cm below the axilla, to the middle of the planned skin paddle. If you have done an axillary dissection and identified the thoracodorsal vessel already, this incision can be made from the axillary incision and carried downwards along the anterior border of the latissimus dorsi.

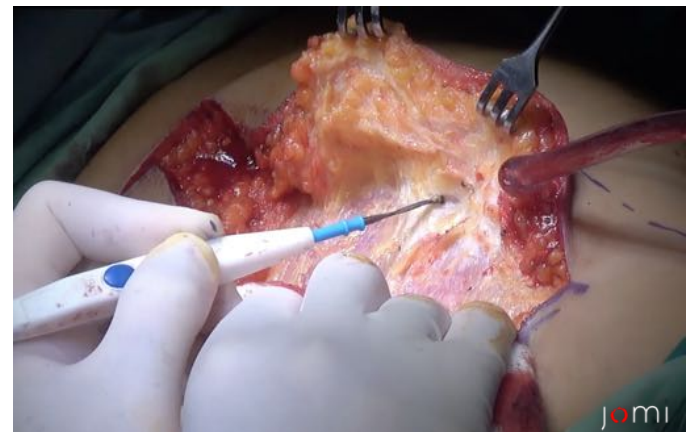


An incision along the latissimus dorsi muscle (solid Purple line,) ending near the measured point of entrance of the

15. Elevate the skin off of the LD surrounding the pedicle.



Incise the skin down to the fascia of the muscle. The thoracodorsal vessels are deep to the muscle and are not vulnerable to injury at this point. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>



Dissect the subcutaneous fat off the LD muscle, all the way to the anterolateral and posteromedial edges of the muscle. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

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At the anterior border of the muscle, dissect this edge of muscle off of the surrounding tissue. The serratus anterior muscle, with its more transversely oriented fibers, will be underneath.

Source: Hallock GG and Young Sang Y, Journal of Medical Insight

<https://jomi.com/article/290.7>

16. Incise the skin to make the distal edge of the skin paddle. Make this incision diagonally away from the skin as above, to assure a good base and blood supply for the skin from the muscle underneath.



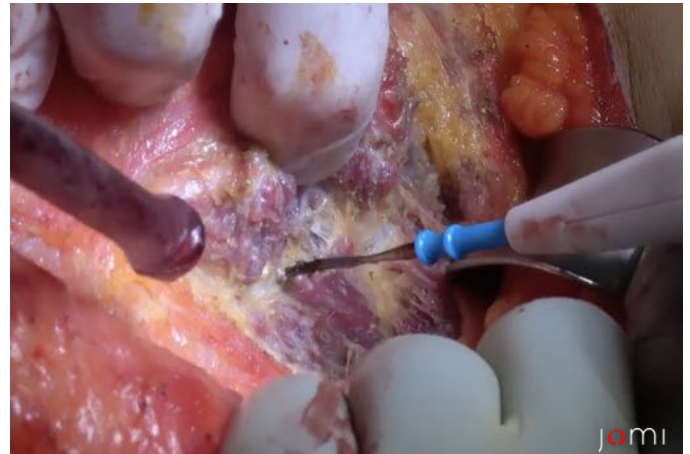
The skin of the caudal side of the skin paddle is incised in a diagonal manner, assuring that the skin rests on a solid base and has good blood supply from the muscle underneath.

Source: Hallock GG and Young Sang Y, Journal of Medical Insight

<https://jomi.com/article/290.7>

17. Some surgeons “tack” the dermis of the skin paddle to the muscle fascia circumferentially, to prevent shear forces from damaging the paddle’s blood supply. We do not do this routinely but if the paddle’s attachment to the muscle is under tension once it is in place, we will do this with interrupted absorbable sutures.

18. Beginning at the inferior edge of the skin paddle, dissect the latissimus dorsi muscle off of the chest wall and serratus anterior muscle.



After dividing the caudal end of the LD muscle, lift the muscle upwards and begin dissecting it off the chest wall.

Source: Hallock GG and Young Sang Y, Journal of Medical Insight

<https://jomi.com/article/290.7>



As you continue the dissection in a cranial direction, the plane will become more clear. Either dissect all of the muscle at this point, or divide part of it medially and leave it behind, preserving any of the muscle that supports the skin paddle.

Source: Hallock GG and Young Sang Y, Journal of Medical Insight

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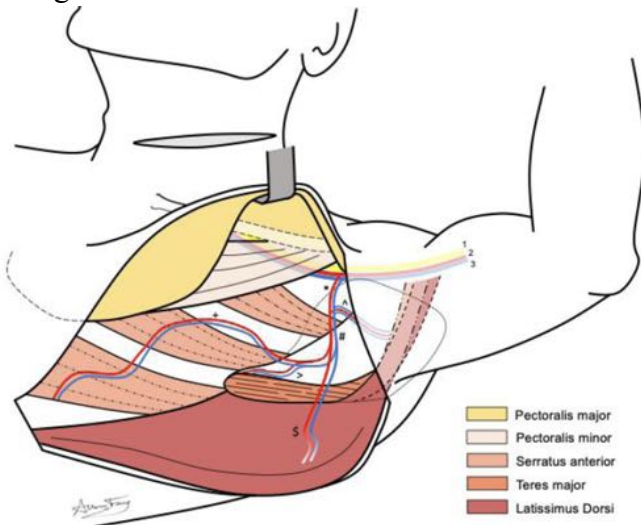
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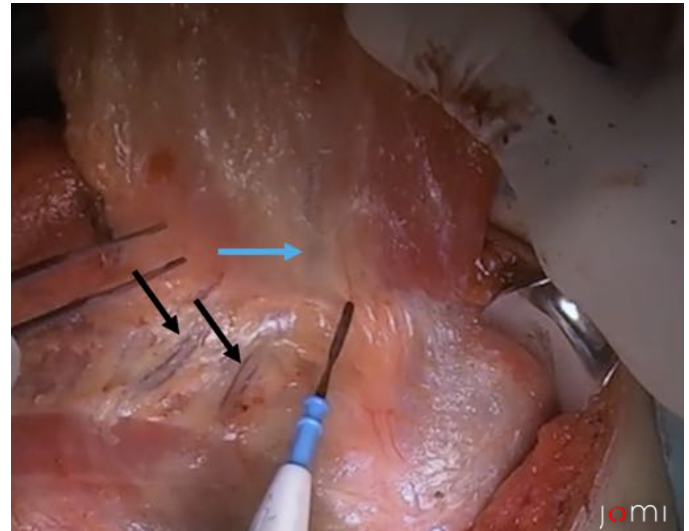


As dissection proceeds, perforating blood vessels will appear and must be individually ligated. Watch for signs that the thoracodorsal vessels are near, as shown below. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

19. As you approach the area 10cm below the axilla, watch carefully for the area where the thoracodorsal vessels enter the muscle. One sign will be a “crow’s foot” of perforator vessels going from the LD muscle into the serratus anterior muscle. These must be individually ligated and divided.



Schematic of the neurovascular supply of the latissimus dorsi. The thoracodorsal vessels give off branches to the serratus anterior (denoted by >) and the scapula (denoted by ^). The branch to the serratus must sometimes be divided to mobilize the flap, if it needs to go far. The branch to the scapula does not need to be divided, but can be if more mobility is needed. Source: Feng AL, et al. Plast Aesthet Res 2021;8:14.

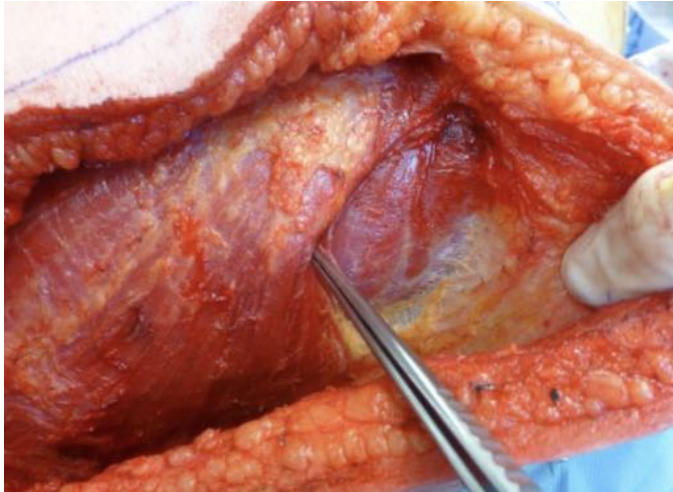


During the dissection, these two vessels in the shape of a “crow’s foot” were seen (Black arrows.) Further careful dissection revealed that these were branches from the thoracodorsal vessels, and pointed towards the main thoracodorsal pedicle running into the muscle (Blue arrow.) Further dissection at this point should be with bipolar diathermy or sharp dissection and ligation, rather than monopolar diathermy, which can damage the blood vessels. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

20. Continue to dissect the latissimus dorsi muscle proximally up to the axilla, dividing any branches of the thoracodorsal vessels that do not supply the LD. Dissection here should not be with monopolar diathermy, use bipolar if available, or else dissect sharply and individually ligate any vessels. Try to preserve a layer of fat around the thoracodorsal vessels rather than dissecting directly on them.
21. At the medial portion of the latissimus dorsi muscle, there will be some muscle attachment to the scapula and the teres major muscle. If these are not too close to the main vessels, divide them with diathermy.

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At the upper medial border of the left latissimus dorsi the muscle is adherent to the scapula and teres major muscle (underneath the forceps.) Source: Open Access Atlas of Otolaryngology, Head and Neck Surgery <http://www.entdev.uct.ac.za/guides/open-access-atlas-of-otolaryngology-head-neck-operative-surgery>

22. It is possible to mobilize the latissimus dorsi all the way up to its insertion on the humerus, and even to disconnect it here in order to get more length. Continue dissection as far in a cranial direction as you need to go. Keep the thoracodorsal vessels in sight at all times, ligating any branches that don't go into the muscle. Continue until the skin paddle reaches the defect without any tension.
23. Confirm that the skin paddle still has good blood supply after dissection. It should "blanche" (turn pale) and then return to normal color when you push gently on the skin with an instrument and then remove it.



The handle of a hemostat was pressed gently against the skin. After it was removed, a faint white outline remained (Black

arrow.) This disappeared after 5 seconds, indicating a good arterial supply and venous drainage to the skin paddle. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

24. Once the flap is mobile, assure that there is a tunnel in the subcutaneous space that is wide enough to allow the muscle to pass without constricting it, as this would compromise the blood supply of the skin paddle. You may need to reposition the patient at this stage. If so, close part of the wound, place the flap loosely within the skin incision, and apply a loose dressing. Then re-prepare and drape the axilla and defect together.



The defect on the back where the paddle originated has been closed, along with some of the vertical incision. The patient has been returned to the supine position. The flap, now fully mobilized up to the axilla, is ready to be tunneled under the skin of the left chest and the paddle placed in the anterior neck defect that resulted from contracture release.

25. Pass the skin and muscle through the tunnel into the defect. Confirm that it lies here without tension and does not try to "retract" when you let go of it.

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Gently pass the skin paddle through the tunnel you have created. In this instance, a suture has been passed through the skin edge and is used to gently pull it through, while the assistant guides it and makes sure it is not twisted or kinked in the process. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

26. Once the flap is mobile, check for hemostasis at the harvest site. Then close the skin in two layers with simple interrupted absorbable sutures through the subcutaneous fascia, followed by interrupted Nylon horizontal or vertical mattress sutures through the skin. Using a running suture on the skin can lead to dehiscence of the entire wound if the suture breaks or tears through in one location, especially if there is some tension on the closure. Place a drain in the space where the muscle was harvested from, to avoid a seroma which can become infected.



The first layer of closure of the flap harvest site is the subcutaneous fascia, which is closed with interrupted absorbable sutures. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>



The second layer of closure is the skin, with interrupted nonabsorbable sutures that distribute the tension evenly across the wound. Source: Hallock GG and Young Sang Y, Journal of Medical Insight <https://jomi.com/article/290.7>

27. The skin paddle is sutured into place, again using a combination of deep absorbable and cutaneous nonabsorbable interrupted sutures.



Flap sutured into place with a closed-suction drain to prevent fluid collections. Using interrupted sutures assures that if one stitch should pull through, the closure would still be held by the others.

Pitfalls

- The most dreaded complication is necrosis of some or all of the flap. This can be prevented by strictly adhering to the principles in this article, reinforced below.
- Before harvest, proper measurement of the distances will prevent any tension on the muscle or the skin once they are in place.
- During harvest, all of the skin paddle should be harvested from directly above the latissimus

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dorsi muscle. Assure that the incision through the subcutaneous tissue “tapers” down towards the muscle. The skin should rest on a base of subcutaneous tissue and muscle that is wider than the skin itself.

- During placement of the skin paddle, it must be protected from shearing or being pulled away from the muscle when it is in place. Tack the dermis of the skin to the latissimus dorsi muscle underneath if necessary to relieve tension at this location.
- Avoid tension or pressure on the muscle. Any skin “tunnel” that it passes through must be very loose.
- If, due to improper measurement, the skin paddle will absolutely not reach the defect it is intended for, the latissimus dorsi muscle can be divided very high in the axilla. Take great care not to harm the thoracodorsal neurovascular bundle. Generally a few cm can be gained by this maneuver. Be certain that the neurovascular bundle is not under tension once this is done, since the pedicle is not protected by the muscle from being stretched.
- Necrosis of a part of the skin pedicle does not necessarily mean that the rest of the skin will die. This can be managed with debridement and resection of the dead portion and release of any purulent fluid underneath.
- Dehiscence of the flap’s donor site can be prevented by keeping drains in the area from becoming clogged. If you can keep infected fluid from accumulating beneath your closure, it will generally heal. It is acceptable to irrigate drains with a small amount of sterile water or saline, using meticulous sterile technique, to unblock them. If dehiscence occurs, it is managed by debridement of dead tissue, dressing changes and keeping the area clean, and repeat primary closure if possible. Otherwise, the defect can be closed with a skin graft.
- As with Axillary Dissection, one consequence of this operation is frozen shoulder. Aggressive physiotherapy for range of movement is necessary, once the wounds have healed enough that this will not cause a dehiscence.

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