

# Great Toe Tip Reconstruction after Severe COVID-19 Using Hemi-pulp V-Y Advancement Flap: A Case Report

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**Summary:** “COVID toe,” one of the extrapulmonary disorders of coronavirus disease 2019 (COVID-19), may result in toe necrosis. In this case, we successfully reconstructed a severe COVID-19-induced defect in the great toe by using an innervated hemi-pulp V-Y advancement flap. A 48-year-old woman was diagnosed with fulminant myocarditis due to COVID-19 and received intensive care. Even after the acute phase, a skin defect measuring 10 mm × 7 mm was noted, exposing the underlying bone on her right great toe tip. Because of ulceration, she was unable to start walking training. To continue rehabilitation, we reconstructed it with the innervated hemi-pulp V-Y advancement flap. The pain improved quickly, and rehabilitation was resumed. During the 6-month follow-up period, no cosmetic or functional complications were observed. Plantar pressure measurements demonstrated favorable loading on the great toe, and it was a favorable outcome in walking function. This flap is a valuable option as one of the innervated flaps for toe-end necrosis with preserved blood flow, which helps in implementing prompt gait rehabilitation. (*Plast Reconstr Surg Glob Open* 2024; 12:e5661; doi: [10.1097/GOX.0000000000005661](https://doi.org/10.1097/GOX.0000000000005661); Published online 14 March 2024.)

The term “COVID toe” refers to a pernio-like skin lesion that can occur after coronavirus disease 2019 (COVID-19). This may occasionally lead to toe necrosis.<sup>1</sup> Several studies have reported on symptomatic treatment; however, no study has reported surgical interventions.<sup>1</sup> To our knowledge, this is the first reported case of reconstructive surgery for necrosis resulting from COVID-19, using an innervated hemi-pulp V-Y advancement flap. A favorable outcome was achieved, in terms of both esthetic appearance and functional prognosis.

## CASE REPORT

A 48-year-old woman with no previous medical history presented to the hospital emergency room with chest and back pain. The SARS-CoV-2 polymerase chain reaction

test was positive, and she was diagnosed with fulminant myocarditis caused by COVID-19. The patient was intubated and placed on veno-arterial extracorporeal membrane oxygenation in the intensive care unit.

The patient’s overall physical condition became stable after the termination of veno-arterial extracorporeal membrane oxygenation and ventilator after several days. Twenty-one days after hospitalization, pernio-like skin lesions were observed on her foot dorsum and a black skin lesion was noticed on her right great toe tip. The necrotic lesion was debrided, leaving a skin defect (measuring 10 × 7 mm) with consequent bone exposure (Fig. 1). During the treatment course of COVID-19, the patient developed a common peroneal nerve paralysis in the contralateral lower limb. Walking rehabilitation was recommended; however, she was unable to participate due to pain from the ulceration of her great toe tip.

Due to the importance of her rehabilitation, we planned to reconstruct the great toe defect. Three-dimensional computed tomography angiography and color Doppler ultrasonography were performed, and no signs of arterial stenosis or occlusion were identified.

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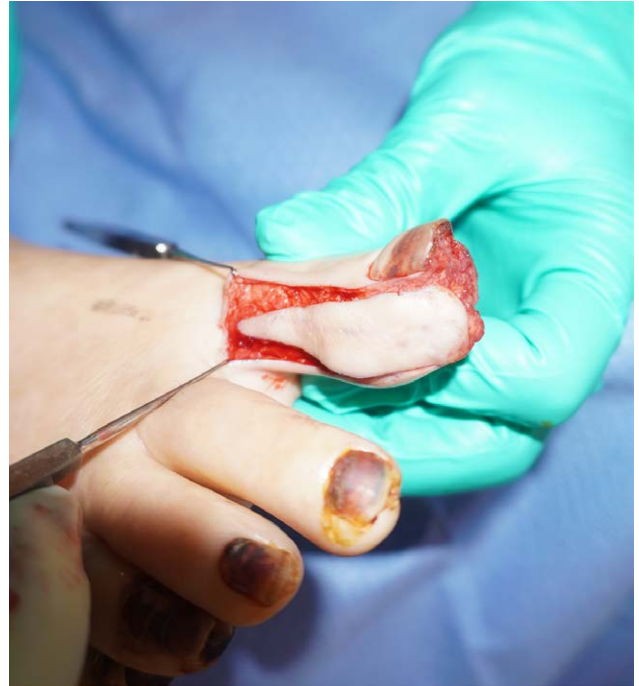


**Fig. 1.** Skin defect (size, 10 × 7 mm) with exposure of the underlying bone caused by the COVID toe. Pernio-like skin lesions on the dorsum of the foot and a black skin lesion on the right great toe tip were observed on day 21 after hospitalization. Debridement of the necrotic lesion resulted in a skin defect (size, 10 × 7 mm) that resulted in exposed the bone.

During her reconstruction surgery, an innervated hemi-pulp V-Y advancement flap was created. The flap was a homodigital and axial pattern flap, which was designed on the midline of the lateral aspect of the great toe, with the width of the vertical diameter of the defect. The pedicle was undermined and dissected proximally by 20 mm to ensure mobility. The flap, including the vessels and surrounding soft tissue, was advanced 10 mm in the rotational direction to cover the defect. The flap included the lateral aspect of the digital artery and the terminal branch of the deep peroneal nerve (Fig. 2).

The flap survived completely without infection or any other complications. Two weeks after surgery, the patient was transferred for rehabilitation of left common peroneal nerve palsy after the wound had completely healed. She then was able to return to social activities within 4 months.

During the 6-month follow-up, comparing the right and left great toes, the reconstructed right toe showed mild thinning of the lateral subcutaneous tissue, but no shortening of the length compared with the left. No other cosmetic complications were observed (Fig. 3). She had no pain in her right foot. The two-point discrimination in the flap of the right great toe was 5 mm, which was equal to that of the left great toe. There were no new ulcerations on the donor site. (See figure, Supplemental Digital Content 1, which shows the donor site of flap and the toe tip at immediately postoperative and 6 months postoperative. <http://links.lww.com/PRSGO/D113>.)



**Fig. 2.** Innervated hemi-pulp V-Y advancement flap was used for the great toe tip defect. The flap was designed on the midline of the lateral aspect of the great toe. It was advanced 10 mm in the rotational direction to cover the defect. This included the lateral aspect of the digital artery and the terminal branch of the deep peroneal nerve.



**Fig. 3.** At the 6-month follow-up, the reconstructed right toe showed mild thinning of the lateral subcutaneous tissue, but no shortening of the length compared with the left great toe. No other cosmetic complications were observed. The patient had no pain in her right foot. The two-point discrimination in the flap of the right great toe was 5 mm, which was just equal to that of the left great toe.

The pressure applied to the reconstructed site during walking was evaluated using the Pedar system (Novel, Germany), an insole-type pressure distribution-measuring device designed to measure the load on the plantar surface during ambulation. Eight steps were evaluated per

straight-line walk, and five walks were assessed per session on the same walkway. Moreover, 99 sensors were distributed into five plantar regions (heel, midfoot, metatarsal, great toe, and toes from 2 to 5),<sup>2</sup> and the mean of each region's peak pressure (PP) was calculated. Under the system, the great toe is the foot part that receives the highest PP during normal walking.<sup>2</sup> The PP of one of her sessions is shown in Figure 4.

The mean PP of the reconstructed great toe was  $347.5 \pm 13.9$  kPa, which was the highest pressure detected on the right sole. The PP of the contralateral great toe was  $266.5 \pm 20.7$  kPa, which was the highest of the left PPs. This was a favorable outcome in terms of both aesthetic appearance and the function of sensory and walking activities.

## DISCUSSION

COVID toe is a skin disorder that is assumed to be caused by some microangiopathy associated with type 1 interferon.<sup>1</sup> Many patients recover through conservative treatment in 10–15 days, sometimes using nonspecific topical corticosteroids, heparin gel, and similar approaches.<sup>1</sup> No studies have reported instances of surgical intervention, even in cases with necrosis complicated by bone exposure.<sup>1</sup> Conservative treatment carries the risk of the latent development of osteomyelitis. Delayed wound healing leads to delayed rehabilitation, and secondary healing can result in scarring and persistent pain. Thus, reconstruction methods must be established for swift reintegration into society and attainment of optimal toe functions.

When considering soft tissue reconstruction of the great toe, several options such as amputation, local flap,

and free flap are available.<sup>3</sup> Amputation could negatively affect the ability to walk. Free flap is one of the useful methods; however, it requires a significant surgical invasion, extended surgical duration, and donor sacrifice. Free flaps also do not regain sensory function as quickly as innervated local flaps. The use of a local flap without a branch of a nerve is at risk of sensory function loss. Jeng et al concluded that innervated flaps have a lower ulcer incidence than nonsensate flaps and that local flaps are preferable for smaller defects of plantar forefoot.<sup>4</sup>

The innervated hemi-pulp V-Y advancement flap that we used provided the recovery of sensory function and early rehabilitation. Using this technique like the oblique triangular flap (1980, Vankataswami R<sup>5</sup>) for fingertip reconstruction is common, but its application in toe reconstruction has been rarely reported. Li-Fu Cheng et al<sup>6</sup> have reported the flap for skin defects on the dorsum of the first toe due to trauma, but there are no existing reports of the flap for the apex of toe.

In this case, good plantar pressure on the reconstructed great toe was important for the reestablishment of gait function because peroneal nerve palsy occurred in the contralateral lower extremity. According to Putti et al,<sup>2</sup> the great toe is the part of the foot that receives the highest PP during normal walking, and in this patient, the PP was highest in both great toes. This indicated that the reconstructed great toe was able to fully support the weight and have good sensory recovery and functional reconstruction to withstand the load. The left-right difference in plantar pressure during gait is attributed to the drop foot of the contralateral leg. Depending on the defect's location, we suggest designing the flap outside the great toe because of less shoe stimulation.

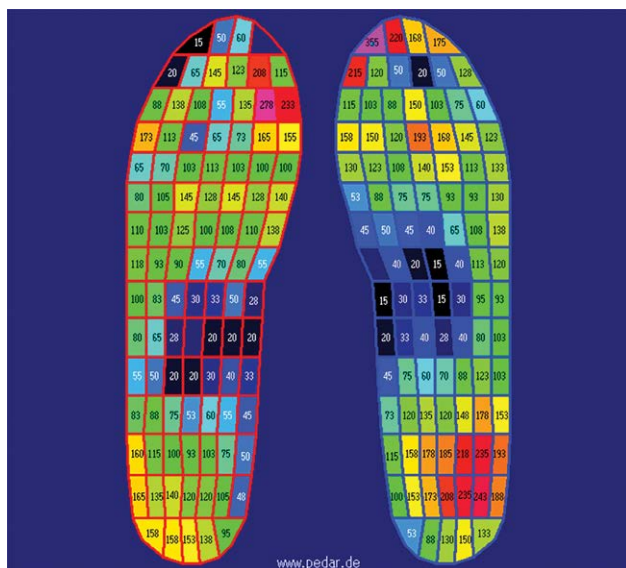
Patency of both digital arteries is necessary when using this flap, and it should not be used in patients with chronic arterial occlusion or otherwise compromised vasculature. Although COVID toe is a vasculitis-like condition,<sup>7</sup> reconstruction was successful by providing a sufficient demarcation period because it is known to be a reversible and temporary vascular lesion.

## CONCLUSIONS

We report a case of reconstructing necrosis of the right great toe caused by COVID toe with a hemi-pulp V-Y advancement flap. The reconstruction resulted in an early return to society and the achievement of good cosmetic and functional results. It is useful as one of the innervated skin flaps in the reconstruction of the apex of the phalanx with preserved blood flow.

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**Fig. 4.** PP per sensor of the sole. The load on the plantar surface was measured during walking using the Pedar system (Novel, Germany), an insole-type pressure distribution-measuring device. Eight steps were evaluated per straight-line walk, and five walks were assessed per session on the same walkway. The PP (kPa) of one of a session is shown.

## DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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