

# De Novo Reconstruction of a Hybrid Patella by Staged Fabrication of a Microvascular Bone Transplant with an Osteointegrated Prosthetic Socket

Goetz A. Giessler, MD, PhD,  
FEBOPRAS\*  
Christian Hendrich, MD, PhD†

**Summary:** Total patellectomy is sometimes unavoidable but usually results in severely impaired function, pain, and instability in the affected knee. Any patellar prosthetic solutions rely on a certain amount of remaining bone and therefore are not applicable after total patellectomy. Traditionally, reconstruction of a neopatella by avascular or allogeneic bone grafts is hampered by mechanical failure, resorption, or infection. We developed a new, 3-stage approach to reconstruct a hybrid patella composed of a revascularized scapula tip transplant fabricated with a prosthetic socket. The procedure is safe and provides optimal healing and prosthetic osteointegration through viable bone and dynamic stability to the considerable load a patella has to bear in unrestricted mobility. The technique also demonstrates successful integration of orthopedic prosthetic devices into current flap fabrication concepts. (*Plast Reconstr Surg Glob Open* 2016;4:e1159; doi: 10.1097/GOX.0000000000001159; Published online 13 December 2016.)

**K**nee arthroplasty in patients with previous total patellectomy (TPE) after trauma or infection has a high complication rate in addition to reduced force and joint stabilization.<sup>1-3</sup> Patellar resurfacing prostheses rely on a minimum of remaining bone. Up to now, avascular<sup>4</sup> or allogeneic grafts<sup>5,6</sup> are being used but have a high risk of infection, slow healing, mechanical failure, or avascular resorption.<sup>4</sup>

Fabrication of chimeric multiflap modules is a valuable option for complex tissue deficits.<sup>7-10</sup> However, only dental implant insertion into a fibula transplant is established in fabricating a free flap with a prosthetic device.<sup>11</sup>

We demonstrate a new option to fully reconstruct a vascularized hybrid neopatella by fabricating a scapular tip osseous free flap<sup>12,13</sup> with an titanium patella prosthesis to overcome the many disadvantages of using avascular bone.

## CASE AND TECHNIQUE

A 32-year-old woman suffered repetitive left patellar dislocations. Various patella-balancing procedures includ-

ing right iliac crest grafts for tibial tuberosity modifications and arthroscopies were unsuccessful. She developed severe retropatellar and tibiofemoral arthrosis and finally underwent TPE. She was referred to us at the age of 50 with a painful arthrosis, requesting total knee replacement and simultaneous patellar reconstruction.

Her right patella was virtually mirrored to create a left stereolithographic (STL) model (Phacon, Leipzig, Germany) to get an idea of the necessary bone stock. The patient refused the harvest from her left iliac crest. The right scapular tip was chosen after computed tomographic determination of thickness and dimensions. Full virtual planning was impossible as vectorized data for the implant socket are unavailable (Zimmer NexGen Trabecular Metal Augmentation Patella, Zimmer Biomet, Warsaw, Ind.).

First, the titanium socket was set into the posterior surface of the right scapular tip after infraspinatus and teres major muscles were partially released. The concave receptacle was burred with the respective spherical mill (Fig. 1), carefully protecting the ramus angularis. The socket was fixed to the scapula with 1.5-mm titanium screws (Medartis, Basel, Switzerland) and covered with silicone sheeting to protect the receptive surface. Surrounding muscles were reattached (**See figure, Supplemental Digital Content 1, <http://links.lww.com/PRSGO/A313>**).

From the \*Clinic for Plastic Reconstructive, Aesthetic and Hand Surgery, Gesundheit Nordhessen, Kassel, Germany; and †Orthopedic Clinic Werneck, Werneck, Germany.

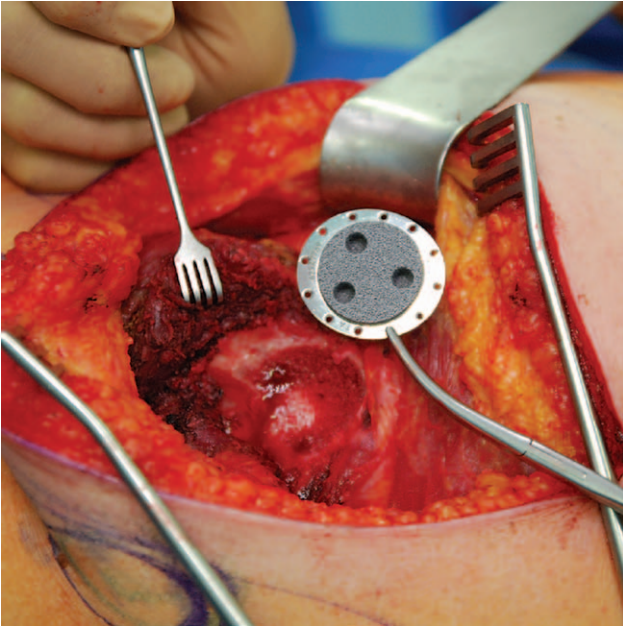
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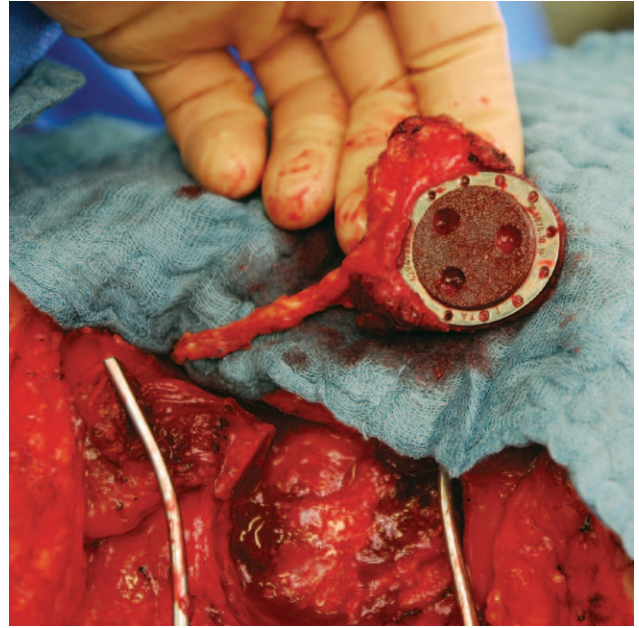
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**Fig. 1.** Right scapular tip burred to receive a patellar prosthetic socket. The Roux hook retracts the latissimus dorsi, the 4-pronged hook retracts the partially elevated teres major muscle.



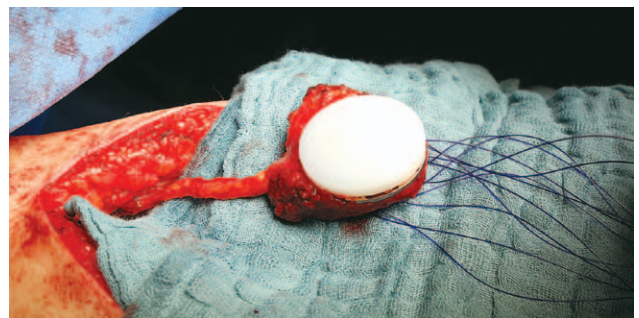
**Fig. 2.** Elevated hybrid flap still pedicled on the angular branch of the thoracodorsal vessels.

Six weeks later, the tibiofemoral prosthetic components were inserted (Zimmer NexGen LPS-flex Legacy Stabilized Total Knee Prosthesis, Zimmer Biomet<sup>14</sup>) followed by knee rehabilitation.

After 3 months, the scapular tip with the osteointegrated socket was harvested as a hybrid prosthetic osseous free flap in the dimensions of the virtual STL patella on its angular branch and thoracodorsal vessels (Fig. 2 and **See figure, Supplemental Digital Content 2**, <http://links.lww.com/PRSGO/A314>). Screws were removed, and the polyethylene gliding cap was cemented onto the receptive surface (Fig. 3). Serratus, infraspinatus, and teres major muscles were reattached. The knee extensor tendon was opened paramedianly, and the hybrid flap was sutured underneath with 0-polydioxanone (PDS) sutures at the correct level above the tibia plateau (Fig. 4). The patellar tendon was closed with strong nonabsorbable sutures, leaving a small gap for the pedicle, which was anastomosed to the descending genicular vessels. Doppler control demonstrated unimpaired perfusion. The patient was mobilized in a knee orthosis in 20° flexion for 6 weeks with crutches and plantar contact weight bearing, followed by physical therapy. Now, 6 months later, she walks pain free with full-weight bearing, has unrestricted range of motion, and can climb stairs. Radiological follow-up shows good healing of the hybrid flap to the tendon and vital scapular bone surrounding the socket without resorption (**See figure, Supplemental Digital Content 3**, <http://links.lww.com/PRSGO/A315>; **See figure, Supplemental Digital Content 4**, <http://links.lww.com/PRSGO/A316>).

## DISCUSSION

Clinical morbidity after TPE is often high. Soft tissues after a TPE are often very compromised, and vascularized tissue would be optimal for patellar reconstruction. Appropriate re-



**Fig. 3.** The polyethylene gliding surface fixed to the prosthetic socket of the hybrid flap with polymethylmethacrylate (PMMA) cement according to the manufacturer (Zimmer Biomet, Warsaw, Ind.). Note the size 0-PDS marionette sutures to fix the hybrid flap underneath the patellar ligament.



**Fig. 4.** Hybrid flap fixed in place through paramedian tenotomy. Note the length of the pedicle to be anastomosed to the descending genicular vessels directly.

recipient vessels were rare after multiple previous operations. Any patellar reconstruction is exposed to extensive mechanical stress. Still, the advantages of vascularized bone transplants over nonvascularized options are important here: they are less susceptible for infection, can grow and adapt to load bearing and stress, are not resorbed, and provide primary healing at their recipient site. We based our hybrid patella reconstruction sequence on the following thoughts: (1) the optimal bone transplant was chosen based on the available pedicle length (very long for the scapular tip<sup>12</sup>) and bone caliber. For our prosthetic system, at least 8-mm bone stock was necessary. STL models and 3-dimensional computer tomographic scans helped in that decision. The iliac crest is an alternative, but a shorter pedicle and higher donor-site morbidity were considered disadvantageous. (2) Pretransfer socket osteointegration avoided the use of PMMA cement with possible thermal transplant damage during simultaneous transfer. The screws fixing the socket to the scapular tip needed to be removed, which is impossible with the polyethylene cap mounted. The joint replacement procedure should not be compromised by simultaneous microvascular procedures. It also needs immediate postoperative physical therapy, which we considered not feasible with simultaneous intraarticular flap transplantation. (3) We placed the vascularized hybrid patellar flap *underneath*, not *inside* the patellar tendon, as knee movement presses the flap against the tendon, providing optimal healing and preventing outward dislocation through a tendon gap. (4) Gliding cap, socket, and scapular tip assembly could technically be done at the first step. We refrained to do this to prevent mechanical irritation and pain by the prosthesis in the scapular region.

This first vascularized patellar reconstruction and the first combination of a scapular tip with a prosthesis as a fabricated flap are options to improve clinical performance after TPE in selected patients but need to be compared with nonvascularized total patella reconstructions to justify their complexity.

**Goetz A. Giessler, MD, PhD, FEBOPRAS**

Clinic for Plastic Reconstructive, Aesthetic and Hand Surgery  
Gesundheit Nordhessen  
Moenchebergstrasse 41-43  
34125 Kassel, Germany  
E-mail: giesslerplasticsurgery@hotmail.com

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