Two-Layer Repair of a Chronic Patellar Tendon Rupture: A Novel Technique and Literature Review

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Abstract

Neglected rupture of the patellar tendon can be a debilitating problem. Various techniques have been described to reconstruct chronic tears. This article presents a simple technique for 2-layer repair of chronic patellar tendon ruptures using Achilles allograft augmentation.

A manual laborer presented to the orthopedic clinic 5 years after sustaining an unrecognized patellar tendon rupture. Despite this significant delay between injury and reconstruction, our patient enjoyed excellent range of motion and full quadriceps strength 19 months after reconstruction.

We believe our technique provides several advantages. By design, the tibial trough was shallower than the depth of the bone block, thus minimizing patellofemoral contact pressure. Transpatellar drilling with the use of a Beath pin makes suture passage easier and provides strong repair permitting early mobilization. Furthermore, our technique spares the remaining native patellar tendon tissue, preserves its insertions, and does not require the use of a tension cerclage wire.

Neglected rupture of the patellar tendon can be a debilitating problem. Scarring of the tendon, superior migration of the patella, and quadriceps contracture result in extension loss and weakness. Various techniques have been described to repair or reconstruct chronic tears of the patellar tendon.[1-14] Because of its availability, use of allograft tissue has proven to be a reliable reconstructive option.

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This article presents a simple technique for 2-layer repair of chronic patellar tendon ruptures using Achilles tendon–bone allograft augmentation. Our technique spares the remaining native patellar tendon tissue, preserves its proximal and distal insertions, and does not require the use of a tension cerclage wire, thus avoiding potential breakage and hardware irritation.

> "We chose Achilles tendon–bone allograft and believe that our novel technique provides several advantages."

Case Presentation

A man in his 40s, whose work included manual labor, presented to the orthopedic clinic with complaints of right knee weakness resulting in instability. Five years prior to presentation, he injured his knee, sustaining an unrecognized patellar tendon rupture. Upon examination, he had a palpable defect in the patellar tendon and a high-riding patella (Figure 1). He had 3/5 quadriceps strength and a 40° extension lag. Plain radiographs revealed patella alta and mild chondromalacia patellae (Figure 2). Options were discussed, and the patient opted for patellar tendon repair.

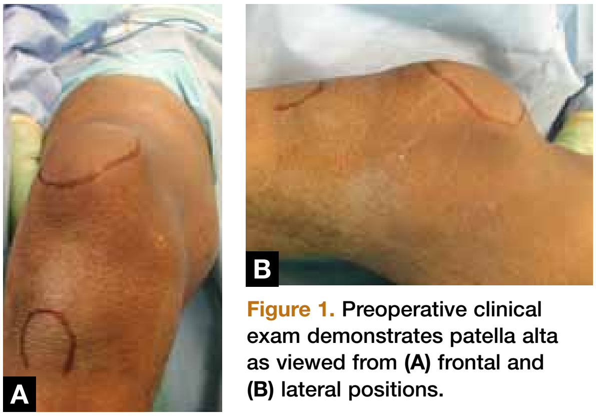


Figure 1. Preoperative clinical exam demonstrates patella alta as viewed from **(A)** frontal and **(B)** lateral positions.

Figure 2. Preoperative **(A)** anteroposterior and **(B)** lateral radiographs demonstrate patella alta and chondromalacia.

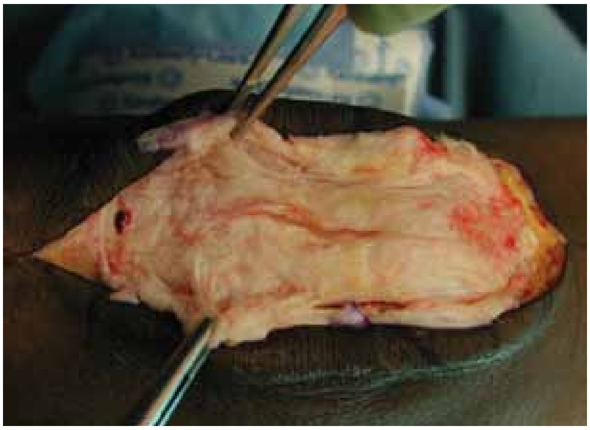


Figure 3. Dense scar tissue immediately encountered after incision.

Surgical Technique

The extensor mechanism was approached through a longitudinal midline incision over the knee. Dissection was carried through the subcutaneous tissue and significant scar tissue was immediately encountered (Figure 3). Thick flaps were elevated medially and laterally, and dissection was continued down until patellar tendon tissue was identified both proximally and distally. The midsection of the patellar tendon was attenuated and lengthened. Normal-appearing patellar tendon tissue remained at both the inferior pole of the patella and the tibial tuberosity (Figure 4). With the knee in full extension, the patella was manipulated with a towel clip and distal traction and was easily reduced into the trochlea. Quadricepsplasty had been considered preoperatively but was not necessary. Referencing a lateral radiograph of the contralateral knee, the normal length of the patellar tendon was measured. A chevron segment of redundant tendon was excised, restoring near-normal tendon length (Figure 5). The remaining tendon edges were re-approximated using two #2 fortified polyester sutures (FiberWire; Arthrex, Naples, Fla.) woven into the tendon stumps using a modified Krackow (interlocking) stitch (Figure 6).

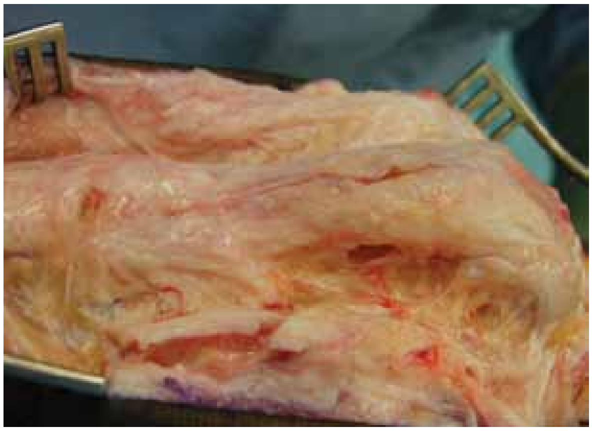


Figure 4. Lateral view of native patellar tendon with intact attachments to the inferior pole and tibial tuberosity.

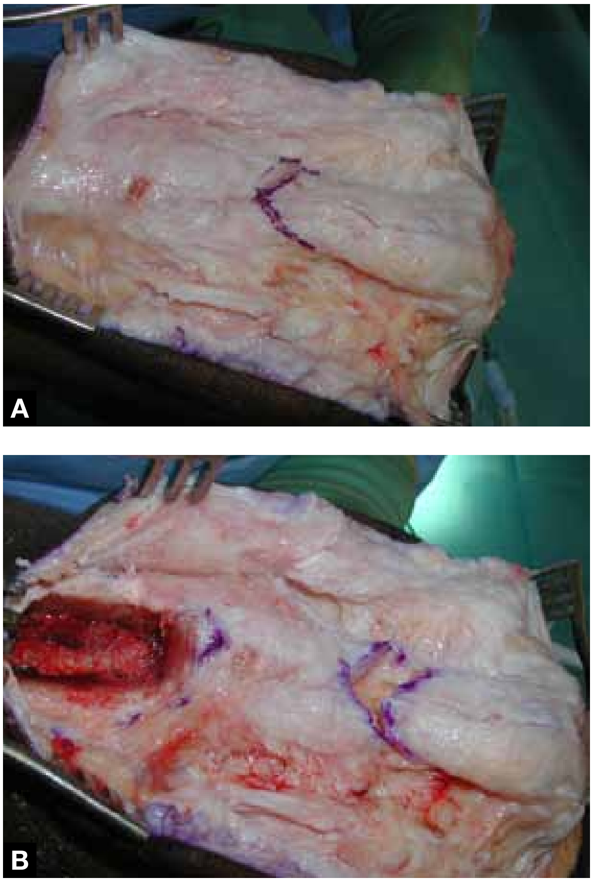


Figure 5. Redundant tendon **(A)** before and **(B)** after excision of a chevron segment.

An Achilles tendon-bone allograft was obtained and the bone block was cut to create a plug measuring 3 cm long, 2 cm wide, and 1 cm deep. A corresponding trough of bone was removed from the proximal tibia immediately distal and medial to the tubercle. The depth of the trough was 5 mm less than the bone block, so that the allograft would not be recessed. The bone block was press-fit into the trough and secured with two 4.5-mm bicortical screws drilled using lag technique. To provide a distal anchor, an 18-gauge figure-of-eight tension band was constructed from the most superior

Figure 6. Repair of native patellar tendon with modified Krackow stitch.

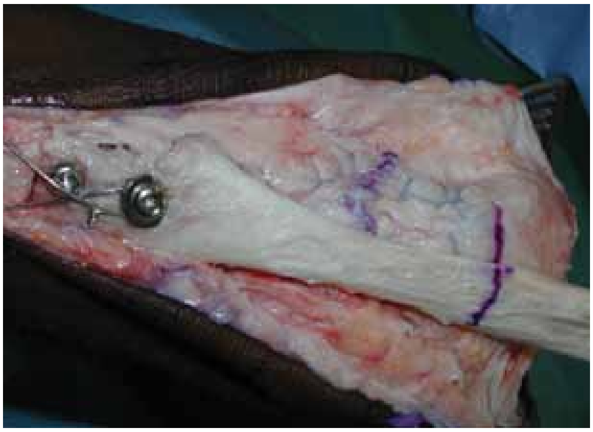


Figure 7. Achilles bone block secured with two 4.5-mm bicortical screws and a figure-of-eight tension band.

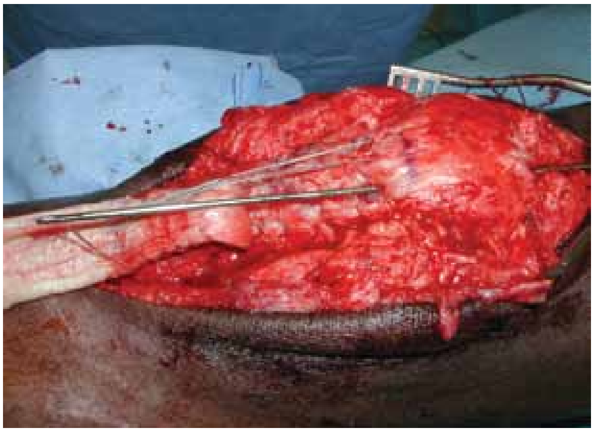
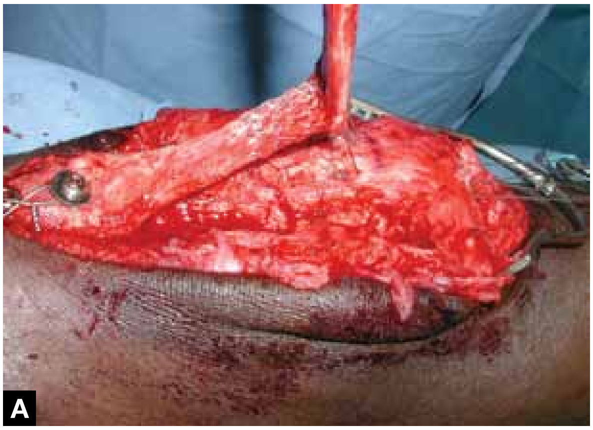


Figure 8. Passage of suture limbs using a 2.4-mm Beath pin.



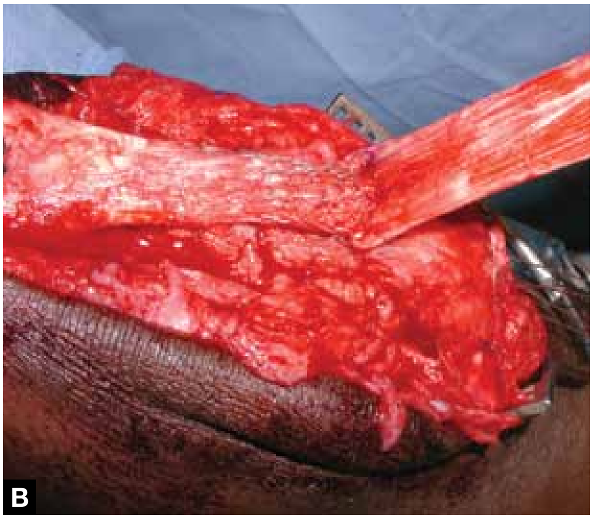


Figure 9. Sutures are **(A)** passed and **(B)** tensioned to maintain native patellar tendon length.

screw through a transverse drill hole across the tibial crest, as described by Emerson[15] (Figure 7).

Two #2 FiberWire sutures were woven through the allograft tendon, creating 2 parallel Krackow stitches with 4 free suture limbs. As described by Labib and Hage,[4] a 2.4-mm Beath pin was used to drill 3 parallel proximal-to-distal tunnels (medial, central, and lateral) through the patella. The Beath pin was then used as a suture passer to shuttle the 2 central suture limbs through the central tunnel and the medial and lateral suture limbs through the medial and lateral tunnels, respectively (Figure 8). Sutures were passed through the tunnels and pulled to maintain the tension created by shortening the patellar tendon to its native length (Figure 9).

Intraoperative radiographs were taken to measure the position of the patella in relation to the tibial plateau and to restore the Caton-Deschamps Index to one[16] (Figure 10). The graft was tensioned in full extension, and the suture limbs were tied over the superior pole of the patella. The remaining allograft tissue was secured to the quadriceps tendon superior to the patella with #1 Vicryl (polyglactin) suture (Ethicon, Somerville, NJ) (Figure 11). The retinaculum was also repaired.

Intraoperative range of motion of 0°–60° was obtained with mild tension noted at the suture site. The thick soft-tissue flaps were easily approximated and closed over the new repair with interrupted figure-of-eight #1 Vicryl suture, possibly providing vascularity to the repair site (Figure 12). Subcutaneous tissue was closed with #2-0 Vicryl suture and the skin was closed with staples.

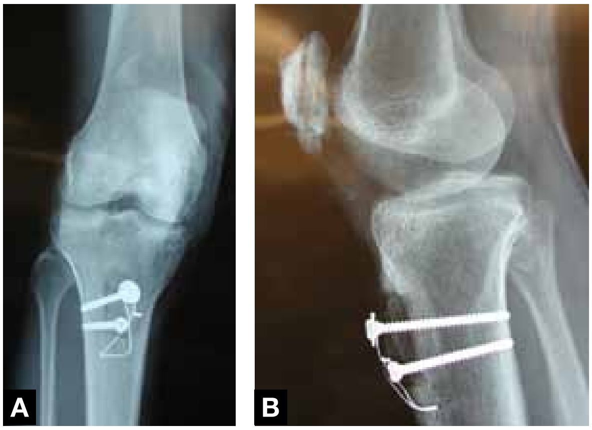


Figure 10. Intraoperative **(A)** anteroposterior and **(B)** lateral radiographs demonstrate restoration of normal patellar height.

Figure 11. Remaining allograft tissue is secured to the quadriceps tendon.

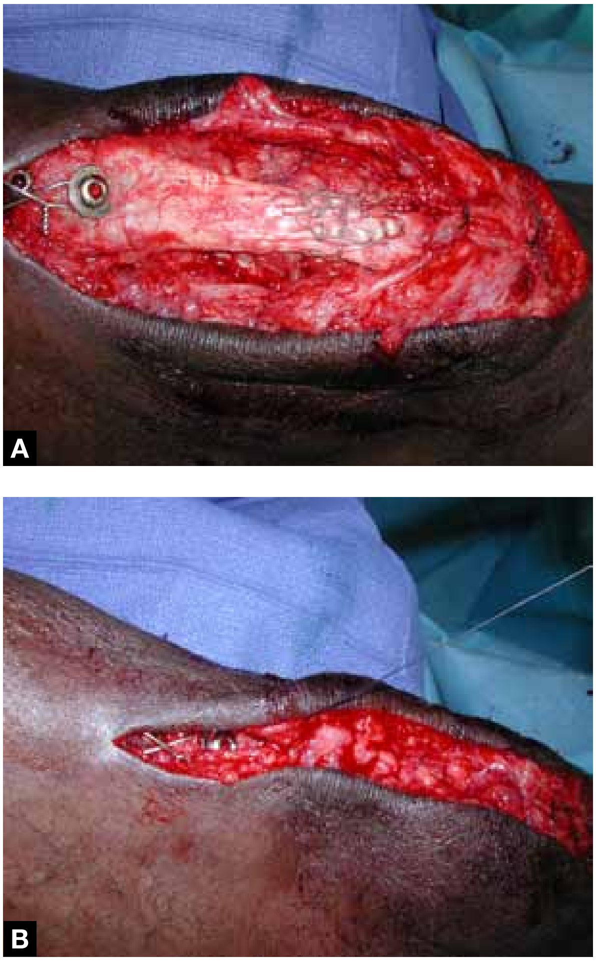


Figure 12. Thick soft-tissue flaps are **(A)** approximated and **(B)** closed over the new repair.

Postoperative Rehabilitation

The knee was immediately placed in a hinged brace locked in full extension. Following staple removal and healing of the soft tissues, motion was allowed between 0° and 30° at 3 weeks, 0° and 60° at 6 weeks, and to 90° at 9 weeks postoperatively. Flexion beyond 90° was allowed after 16 weeks. Return to full activity was permitted at the 6 months' mark.

Results

Preoperatively, the patient had an active motion arc of 40° to 120° with a 40° extension lag and 3/5 quadriceps strength. By the third week after surgery, the patient had a motion arc of 10° to 50° and was capable of performing a straight leg raise. At 7 months after surgery, he enjoyed 0° to 110° passive range of motion with a 10° extension lag and 5/5 quadriceps strength. The patient only complained of intermittent, mild anterior knee pain and had a positive patellar grind. He had no complaints of instability or weakness. Magnetic resonance imaging (MRI) was obtained and revealed an intact extensor mechanism with incorporation of the graft (Figure 13). At 32 months postoperatively, active range of motion had improved to 0°-130° (equal to the contralateral knee) with no extension lag. The patient continued to complain of mild anterior knee pain with a positive patellar grind. Plain radiographs revealed that the patella was well centered in the trochlea, but moderate patellofemoral degenerative changes, as noted on preoperative radiographs, had persisted (Figure 14).

Discussion

Unrecognized or chronic rupture of the patellar tendon is a rare and difficult problem. Scar formation, tissue loss, and weakness result in extension loss.[6] Several techniques have been described to solve this difficult problem, including preoperative and intraoperative traction, quadricepsplasty, repair with autograft or allograft tissue, and the use of synthetic material.[1-5,7-14] This paper describes a single-stage 2-layer technique to repair chronic patellar tendon ruptures using inlay Achilles tendon–bone allograft augmentation.

Siwek and Rao[10] recommended 4-14 days of preoperative traction. Mandelbaum and colleagues[5] advised Z-lengthening of the quadriceps tendon and Z-shortening of the patellar tendon. Casey and Tietjens[2] have described a similar technique of shortening the patellar tendon and reapproximating the

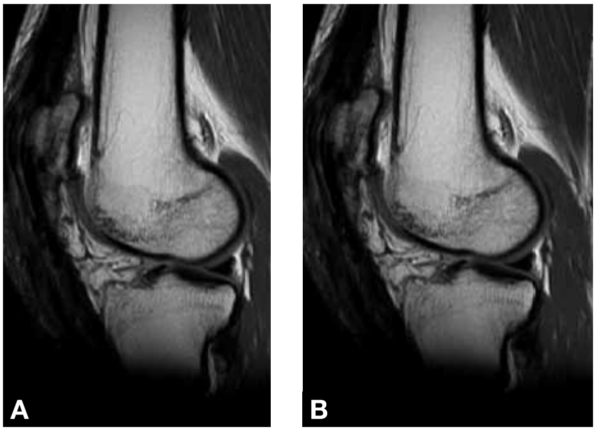


Figure 13. Magnetic resonance imaging 7 months after surgery shows **(A)** an intact extensor mechanism with **(B)** incorporation of the graft.

stumps. However, they used three 1.5-mm wires to reapproximate the tendon and advocated their removal 6 months after reconstruction. In our case, by shortening the tendon and reapproximating the stumps, we were able to mobilize the patella distally into the trochlea without preoperative traction, quadriceps lengthening procedures, or quadricepsplasty. Our experience agrees with that of Emerson[15] that the contracted quadriceps will stretch over time. Use of fortified polyester suture for fixation instead of wire avoids subsequent surgery for removal of hardware and any associated morbidity.

Tendon graft augmentation in chronic patellar tendon reconstruction has been well described. Some authors have described use of autologous fascia lata or augmentation with gracilis and semitendinosis autograft.[5,9,10] Others have even recommended use of contralateral bone–patellar tendon–bone autograft.[14] Currently, allograft is readily available and its use avoids autograft donor site morbidity. Thus, allograft has become a popular choice among surgeons performing chronic patellar tendon reconstructions.[1,3,8,12,13] We chose Achilles tendon–bone allograft and believe that our novel technique provides several advantages. By design, the proximal tibial trough was 5 mm shallower than the depth of the bone block, thus anteriorizing the tibial tubercle and minimizing patellofemoral contact pressure.[7,15] Our technique of transpatellar drilling with the use of a 2.4-mm Beath pin, as previously described for quadriceps tendon repair,[4] makes suture passage easier and provides strong repair permitting early postoperative mobilization. Furthermore, our technique incorporates the remaining healthy native tendon into the reconstruction, preserving its insertions and resecting only the attenuated, unhealthy portions. In addition, we show that normal tendon length can be reliably calculated from a lateral radiograph of the normal contralateral knee.

For the period after surgery, various techniques have been described to protect the newly reconstructed

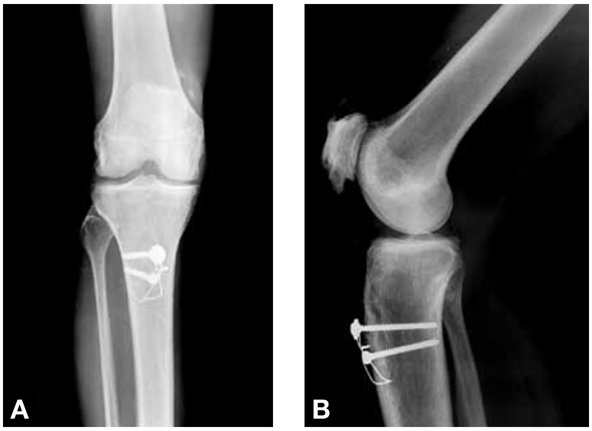


Figure 14. **(A)** Anteroposterior, **(B)** lateral, and **(C)** sunrise radiographs 32 months after surgery show maintainance of normal patellar height and mild patellofemoral osteoarthitic changes.

tendon, including prolonged immobilization with the knee in extension[9,10] and application of patellotibial external fixation.[9-11] In our patient, preservation of the native tendon with its insertion on the tibial tubercle, strong fixation of the allograft to the tibia and patella, and the theoretically enhanced strength and splinting offered by a 2-layer reconstruction permitted early motion without use of external fixation. This, in turn, allowed early, progressive mobilization and stretching out of the previously contracted quadriceps muscle. To accommodate the extra volume of a 2-layer reconstruction, thick medial and lateral flaps were elevated, creating a "pocket" of healthy soft tissue to envelop the graft. Furthermore, the attenuated tendon with its associated blood supply was preserved.[5] We believe that these technical considerations may enhance revascularization of the allograft.

Outcome after surgery is closely related to time between injury and reconstruction. Patients who have undergone late repair are noted to have limitations in range of motion as well as persistent quadriceps weakness and atrophy.[6] Even though 5 years elapsed between injury and reconstruction, our patient enjoyed 0°-130° of active range of motion and full quadriceps strength 19 months after reconstruction. Although the patella was restored to its anatomic position within the trochlea, the patient developed mild anterior knee pain with radiographic evidence of degenerative changes. We believe this may be related to pre-existing patellar osteoarthritis or the abnormal biomechanics and patellofemoral pressures associated with a prolonged period of disruption.[6]

Mandelbaum and colleagues[5] have proposed several considerations in the reconstruction of the neglected patellar tendon disruption, which include the following:

1. Restoration of extensor mechanism length in the setting of quadriceps contracture.

2. Restoration of quadriceps function.

3. Restoration of a congruent patellofemoral relationship.

4. Preservation of vascularity of the reconstructed tendon.

5. Splinting of the patellar tendon reconstruction to permit early motion.

We believe that our single-stage 2-layer technique for reconstruction of the neglected patellar tendon disruption addresses all of these considerations and provided our patient with an excellent outcome.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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