A Percutaneous Technique to Reposition the Cortical Button of Adjustable-Loop Devices in Anterior Cruciate Ligament Reconstruction

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Abstract: Adjustable-loop devices are relatively new but quite popular and have been routinely used for around a decade in arthroscopic anterior cruciate ligament reconstruction for hamstring graft fixation on the femur. They allow surgeons to adapt to different tunnel lengths, eliminate the need for multiple loop sizes, decrease the “bungee cord effect,” maximize the amount of graft within the femoral socket available for incorporation, and allow retensioning of the graft. Apart from these advantages, certain complications are associated with the use of adjustable-loop devices. When the cortical button is being pulled up through the femoral tunnel, it may be pulled up with greater force, causing it to come out of the vastus lateralis, the iliotibial band, or even the skin. When the graft is pulled back from the tibial side, the cortical button may flip in the substance of the vastus lateralis or outside the iliotibial band. This soft-tissue interposition can cause ischemic necrosis of the interposed tissue, soft-tissue irritation, migration of the cortical button, or early loosening of the graft, leading to anterior cruciate ligament reconstruction failure. We describe a percutaneous solution to this common intraoperative technical complication. The outer sheath of a 4.5-mm arthroscope, 4.5-mm acromionizer, or notchplasty burr can be safely used to put the cortical button back against the lateral cortex of the femur.

The principal goal of anterior cruciate ligament (ACL) reconstruction is to provide stable initial graft fixation to allow tendon-to-bone healing. The desired endpoint with any fixation device remains a taut ACL graft. Suspensory fixation on the femoral side is one of the preferred fixation modalities for hamstring grafts.

Adjustable-loop devices (ALDs) have evolved from fixed-loop devices; ALDs are relatively new but quite popular and have been in use for at least a decade now. ALDs have some advantages: (1) A single loop size can be used in all patients irrespective of socket length. (2) ALDs are easy to insert without much intraoperative calculation. (3) The use of ALDs eliminates the need to drill an additional length of the femoral socket that is required for flipping of the cortical button, thus reducing the distance between the button of the adjustable suspension loop and the proximal end of the hamstring graft; hence, the distance of suspensory fixation is shortened, which may potentially decrease the “bungee cord effect,” resulting in less postoperative tunnel widening. (4) The amount of graft within the femoral socket available for incorporation is maximized, which is particularly important with the relatively short femoral sockets. (5) The use of ALDs allows for retensioning of the graft after initial fixation,1 thus obtaining a higher initial force level.2 Although there have been concerns regarding larger elongation values in all available ALDs compared with fixed-loop devices in various biomechanical studies,3 ALDs continue to be used with equivalent clinical success.4 Certain complications are also well reported with the use of ALDs. When the cortical button is being pulled up through the femoral tunnel, it may be inadvertently pulled up with greater force, which can cause the ALD button to come out of either the vastus lateralis, the iliotibial band, or even the skin.5 In this scenario, when the surgeon attempts to pull back the graft to seat the cortical button, the button may flip in the substance of the vastus lateralis or outside the iliotibial band. This malposition of the cortical button of the ALD causes
soft-tissue interposition, which has several potential complications. It can cause ischemic necrosis of the interposed tissue, soft-tissue irritation, or migration of the cortical button itself. It can also cause early loosening of graft, leading to ACL reconstruction failure. All these complications may require second-look surgery, which is undesirable.

To correct this situation intraoperatively, repositioning the cortical button into its desired position on the femoral cortex can be achieved by incising the interposed soft tissue and verifying the positioning under direct vision by an open method. We describe a simple percutaneous solution to this intraoperative technical complication.

Fig 1. The button of the adjustable-loop device (ALD) is flipped in the soft tissue. (A) An arthroscopic image (viewed through standard anteromedial portal) of the ALD at the femoral aperture level shows that the marks made on the ALD loop (arrow) do not come back to the level of the aperture. (B) By use of an image intensifier, the button of the ALD is lying in the soft tissue (arrow) away from the lateral femoral cortex.

Fig 2. Technique to reposition button (patient in supine position, ACL reconstruction being performed on left side). (A) A small stab incision (arrow) is made to deliver the button gently out of the skin. (B) All sutures are passed through an arthroscope sheath, and the button is pulled into the sheath. (C) The sheath is advanced through the soft tissue until it hits the femoral cortex. (D) The graft is pulled out from the tibial side, automatically flipping the button on the femoral cortex (arrow), as confirmed by the image intensifier. (E) On viewing arthroscopically through standard anterolateral portal, the marks on the loop of the adjustable-loop device (arrowhead) are coming back to the level of the femoral socket aperture, denoting button redeployment on the femoral cortex.
Table 1. Pearls and Pitfalls

| Pearls | Pitfalls |
|--------|----------|
| The cortical button should be taken out of the skin; otherwise, it is difficult to negotiate through the arthroscope sheath. | The threads may be cut during the stab incision in the skin. |
| The inner diameter of the arthroscope sheath should be greater than the transverse diameter of the cortical button. | The ALD loop may be damaged if the leading threads and graft are not kept under tension while the arthroscope sheath is being slid down. |
| The iliotibial band should be dilated with a straight hemostat before the arthroscope sheath is pushed. | When using an ALD (ProCinch; Stryker, Kalamazoo, MI), it is recommended to measure the tunnel length and mark this on both sides of the loop. This ensures that when the marks enter the aperture of the femoral tunnel, the cortical button can be flipped safely outside the femoral cortex. Once the cortical button is flipped, the marks should be just at the aperture level. Overshooting of the cortical button is suspected when the marks on the loop go inside the tunnel and do not come back to the level of the aperture when pulling from the tibial side of the graft (Fig 1A, Video 1). The surgeon may notice a dimple appearing in the soft tissue at the exit of the sutures when the graft is pulled down from the tibial side. An image intensifier can be used to obtain an anteroposterior view to confirm the position of the cortical button in the soft tissue away from the femoral cortex (Fig 1B). Sometimes, the cortical button can also come outside the skin. This complication can be reverted using the standard arthroscope sheath (Stryker) for the 4.5-mm 30° viewing arthroscope itself by following the steps presented herein. |

### Technique

When using an ALD (ProCinch; Stryker, Kalamazoo, MI), it is recommended to measure the tunnel length and mark this on both sides of the loop. This ensures that when the marks enter the aperture of the femoral tunnel, the cortical button can be flipped safely outside the femoral cortex. Once the cortical button is flipped, the marks should be just at the aperture level. Overshooting of the cortical button is suspected when the marks on the loop go inside the tunnel and do not come back to the level of the aperture when pulling from the tibial side of the graft (Fig 1A, Video 1). The surgeon may notice a dimple appearing in the soft tissue at the exit of the sutures when the graft is pulled down from the tibial side. An image intensifier can be used to obtain an anteroposterior view to confirm the position of the cortical button in the soft tissue away from the femoral cortex (Fig 1B). Sometimes, the cortical button can also come outside the skin. This complication can be reverted using the standard arthroscope sheath (Stryker) for the 4.5-mm 30° viewing arthroscope itself by following the steps presented herein.

### Step 1

A small stab incision is made along the sutures coming out on the lateral side of the femur, and the cortical button is gently pulled just outside the skin (Fig 2A, Video 1).

### Step 2

All the sutures on the cortical button are passed through the sheath of the 4.5-mm 30° arthroscope. Then, the leading suture is pulled up to allow the cortical button to enter the sheath in an unflipped position (Fig 2B, Video 1).

### Step 3

The arthroscope sheath is slid down, keeping all the threads under tension, until it passes through the iliotibial band and vastus lateralis muscle and its tip is seated against the lateral cortex of the femur (Fig 2C, Video 1).

### Step 4

The graft-ALD construct is pulled down from the tibial side (Video 1). As soon as the cortical button exits the sheath, it is flipped against the lateral cortex of the femur, which can be verified under the image intensifier (Fig 2D). Flipping of the cortical button against the lateral cortex of the femur can also be confirmed arthroscopically by the return of the marks on the loop at the level of the femoral aperture (Fig 2E). Certain pearls and pitfalls should be remembered by the surgeon while following our technique (Table 1).

### Discussion

ALD fixation is gaining acceptance worldwide, being versatile and easy to use. The risk of overpulling and flipping the button in the soft tissue is a well-known complication. This complication is more common for surgeons in the initial phase of using ALDs or in the hands of assistants pulling the graft into the femoral socket. With experience, surgeons learn to pull the graft-ALD construct in a controlled manner, usually by rolling around medium-sized artery or Kocher forceps while keeping gentle countertraction on the tibial side of the graft and visualizing the marks arthroscopically.

Nag and Gupta\(^5\) described direct visualization of the TightRope RT button (Arthrex, Naples, FL) in the femoral socket during its passage and a controlled push directly on the button with the help of a guide pin to prevent the aforementioned complication. This technique is operator dependent and specific to the device manufacturer. However, when the aforementioned complication occurs, the surgeon has to make a 1.5- to 2-cm incision in the skin and cut the fascia lata and vastus lateralis muscle under vision directly to seat the button on the femoral cortex while taking care not to inadvertently damage the sutures coming out on the femoral side. This results in another scar on the femoral side. Sonnery-Cottet et al.\(^8\)

### Table 2. Advantages and Disadvantages

| Advantages | Disadvantages |
|------------|---------------|
| Scarring on the femoral side is minimal. The arthroscope sheath provides a safe passage for the cortical button without dissecting the interposed soft tissue. | The tip of the arthroscope sheath may be damaged. (As an alternative, disposable items such as the outer sheath of a 4.5-mm acromionizer burr or notchplasty burr can be used.) |
| Special equipment is not required. The technique uses tools available among the usual arthroscopic instruments. | There is a risk of radiation exposure to the patient. |
described a technique for arthroscopic confirmation of button deployment. This technique uses outside-in femoral drilling with cleaning of the button deployment site in the lateral femoral gutter, which has a learning curve for adoption in all cases. In addition, the cortical button deployment site in the lateral gutter restricts tunnel placement into a specific area of the ACL footprint. It is not useful for surgeons using an inside-out technique for femoral drilling in a position of hyperflexion because the exit of the femoral socket is outside the lateral gutter. Mistovich et al.9 described direct endoscopic visualization through the iliotibial band portal to facilitate the exact flipping and placement of the cortical button on the lateral aspect of the femoral cortex in pediatric cases. However, this technique requires a longer intraoperative time and a relatively higher level of surgical skill. Ohnishi et al.10 described a dual-lateral femoral portal arthroscopic technique to identify and reposition the cortical button in soft tissue using a shaver and radiofrequency. This technique is also time-consuming; can cause fluid extravasation; and has a risk of damage to the cortical button, the sutures, and even the lateral superior genicular artery.

The use of our percutaneous technique involves certain risks, such as: (1) Damage to the iliotibial band may occur if the track for passage of the arthroscope sheath is not dilated with a hemostat. (2) There is a risk of radiation exposure to the patient if the image intensifier is used to confirm the position of the cortical button. (3) The leading threads of the ALD may be cut when a stab incision is made to take the ALD button out of the skin. (4) The ALD loop may be damaged if the leading threads and graft are not kept under tension while the arthroscope sheath is being slid over the threads. A limitation of our technique is that it is not possible to flip the cortical button back using an arthroscope sheath whose inner diameter is less than the transverse diameter of the cortical button.

The described percutaneous technique has several advantages and a few disadvantages (Table 2). Our technique offers a simple and effective solution to the complication of inadvertent pulling up of the graft and flipping of the cortical button in the soft tissue using the tools usually available on the arthroscopy surgical table and irrespective of the device manufacturer without affecting the duration of surgery.

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