SPLIT PERONEUS BREVIS LATERAL ANKLE STABILIZATION 15 YEARS OF EXPERIENCE AT DOCTORS HOSPITAL

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Introduction

The split peroneus brevis lateral ankle stabilization (SPBLAS) is a useful method for lateral ankle ligamentous reconstruction. It has proven to be a dependable and stable procedure with limited morbidity. The procedure evolved as a modification of the Chrisman-Snook procedure. The procedure in its refined form resembles the procedure initially performed by Winfield in 1953 as a modification of the Watson-Jones technique (Fig. 1).

The SPBLAS procedure is designed to reconstruct the anterior talofibular and calcaneofibular ligaments utilizing a portion of the peroneus brevis tendon as a graft. Reports of short term results and refinements in this technique have been presented at prior seminars. This chapter will focus on refinements of the procedure and discuss their relevance.

At present, we are involved in a critical objective and subjective longterm followup (study) of the procedure. We are looking for ways to objectively evaluate the new tendon-ligament complex. A number of questions must be asked from a scientific standpoint:

What properties does the new tendon-ligament possess?

Does it undergo healing in the same manner as normal tendon and ligament?

Does it possess the same strength and visco-elastic properties as normal ligament?

Does sacrificing a portion of the peroneus brevis have any effect on stability, strength, and function of the foot and ankle complex?

Evaluation of long and short term results of ankle stabilizations by other authors reveal that short term results may be inconclusive and that long-term followup will reveal marked differences. A number of complications have been reported in association with stabilization procedures. In the paragraphs that follow we review these complications as well as our own complications to date.

Indications and Rationale

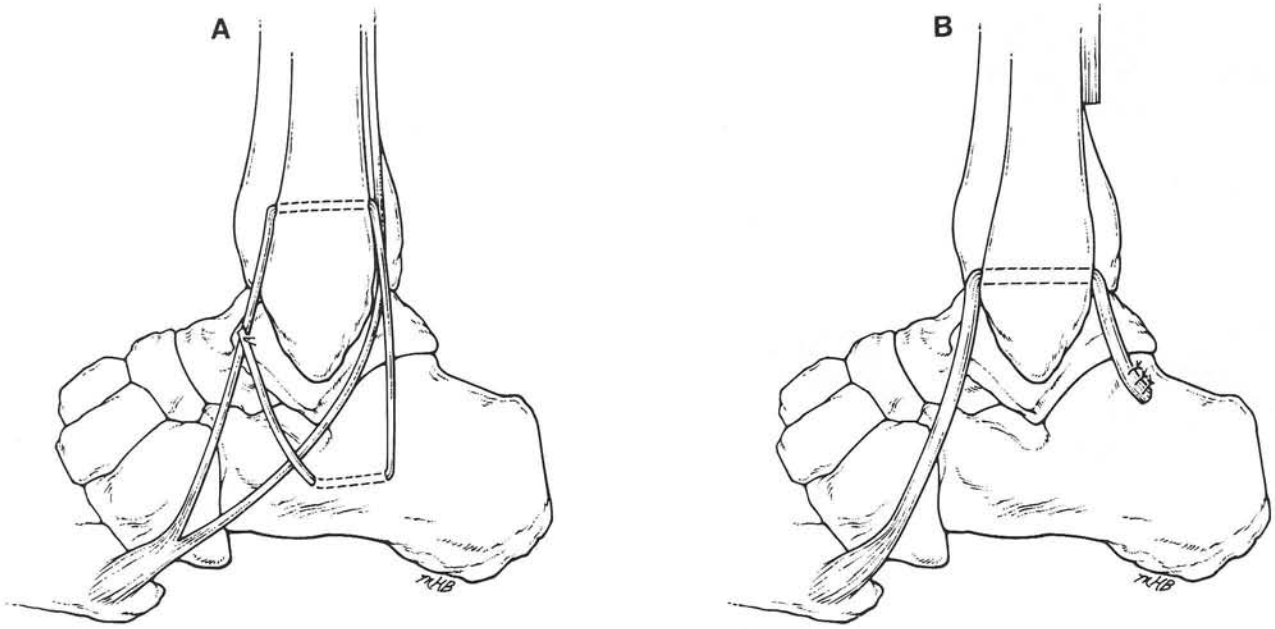
The past decade has seen a new attitude and awareness in the treatment of ankle sprains. Modern day athletics have focused a renewed emphasis on the treatment of this common disorder. Even as this enlightened interest has blossomed, many patients still receive inadequate treatment for total lateral ankle ligamentous disruption.

Patients who undergo lateral ankle stabilizations are generally categorized in the literature by previous treatment methods. The most common treatment groups include the compression splinting group and the benign neglect group. Those individuals who have been treated for a period of four to eight weeks in plaster or synthetic below knee casts have a much lower incidence of chronic instability and associated disability than those who have had less rigid immobilization.

Patients with complaints of daily ankle pain, swelling, interference with daily and competitive activities are candidates for lateral ankle ligamentous reconstruction. The procedure is generally reserved for those patients reporting a longstanding instability and regular occurrences of the ankle "giving out." In their followup paper in 1985, Chrissman, Snook and Wilson stated their procedure was reserved for patients with disabling recurrent instability, who had a failed course of conservative therapy and would continue to subject the ankle to strenuous use.

There are also numerous reports in the literature of delayed primary repair for old ruptured lateral ankle ligaments who present with ankle instability. Advocates primary repair depend upon locating the attenuated remains of the lateral ankle ligaments. This approach has also proved effective in relieving the patient of symptoms and instability. The patient that presents with longstanding recurrent instability may have atrophy of the previously disrupted ankle ligaments. This is the patient that becomes a candidate for ligamentous reconstruction.

Preoperative assessment includes standard radiographic views of the ankle and foot. Both anterior drawer and inversion stress radiography should be performed prior to surgery (Fig. 2). A number of techniques are available to accomplish stress radiography. At the Podiatry Institute the stress radiographs are performed manually. Occasionally, a common peroneal nerve block will be performed utilizing either lidocaine or mepivacaine. Many of the patients who suffer from chronic instability tolerate stress radiography without the use of local anesthetics. Our experience with stress devices is limited at the time of this writing.



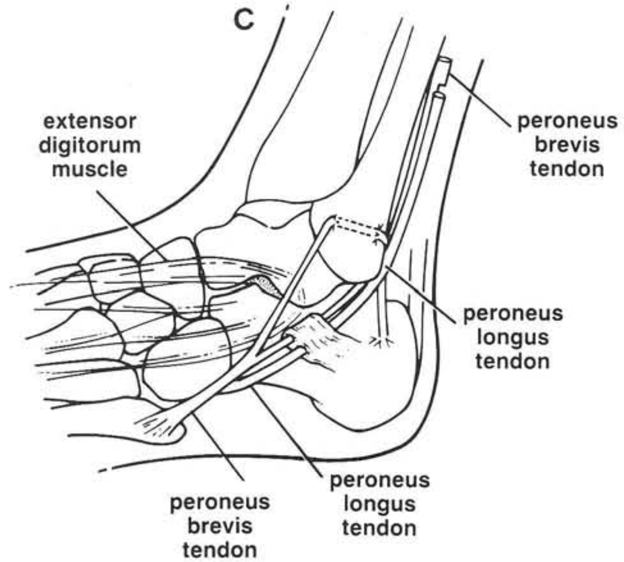


Fig. 1. A. Chrisman-Snook (1969) modification of Elmslee procedure. **B.** Winfield (1953) modification of Watson-Jones procedure. **C.** Doctors Hospital modification, commonly referred to as SPBLAS.

Physical examination of the ankle will commonly reveal a palpable dell along the course of the anterior talofibular and calcaneofibular ligaments. Tenderness may be noted at the ligamentous attachment sites and the anterolateral aspect of the ankle capsule. One must also rule out the presence of subluxating peroneal tendons.

Other Considerations

In selecting a reconstructive procedure for the lateral ankle ligaments, one must consider effects of the tendon-graft. A number of authors have expressed concern over sacrificing a normal functioning tendon or portion of a tendon. Other authors feel the loss of a muscle tendon complex should not influence the choice of procedure.

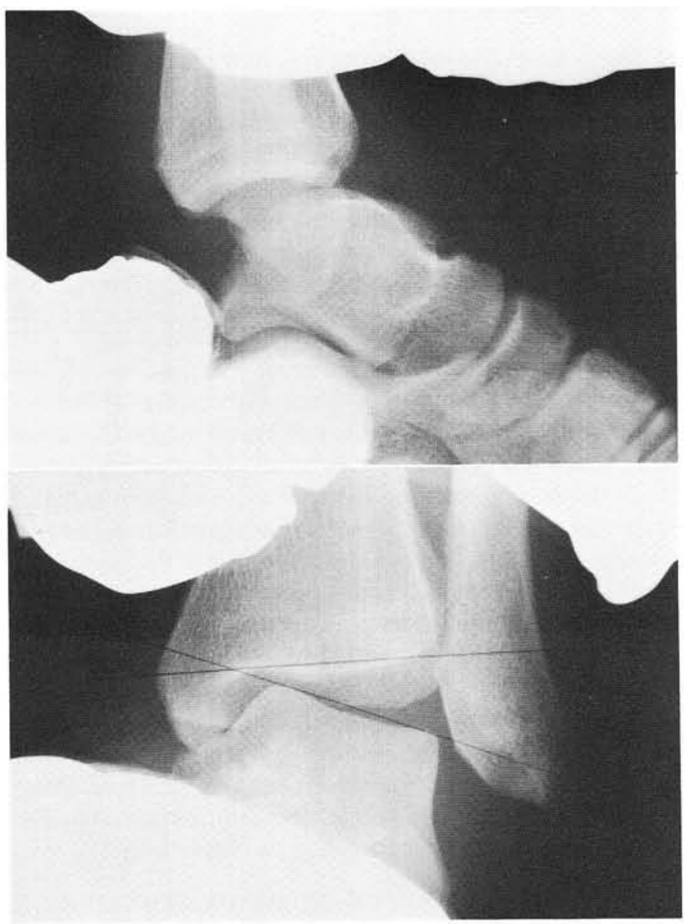


Fig. 2. Stress radiography; positive anterior-drawer and inversion studies.

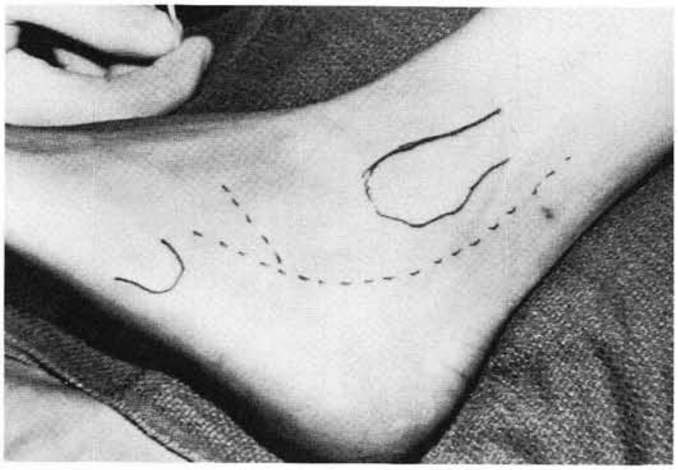


Fig. 3. Patient on a vacuum pack in a lateral decubitus position. Target tissues are identified, fifth metatarsal base, distal one/third fibula, talus and calcaneus.

Various types of testing apparatus have been designed to evaluate the strength of the lateral ankle ligaments as well as tendon grafts. Many of these methods utilize cadaveric or animal specimens in a simulated environment. The tendon grafts have been determined by these methods to be quite capable of tolerating nearly the same forces as intact ligaments.

There is significant controversy in the rehabilitation of chronically injured ankles regarding the strength of the supporting musculature. It has been reported that following stabilization procedures which utilize tendon grafts there is no statistically significant decrease in the strength of the supporting lateral muscular structures. Future evaluation of the lateral muscle groups could include some type of electrodiagnostic evaluation during gait for a more accurate picture.

Recall that the main function of the peroneus brevis muscle tendon complex is to actively stabilize the lateral column of the foot during closed chain kinetics. The lateral column of the foot also receives significant stabilization from the soleus muscle. Together they function to create a stable cuboid (lateral column) to assist in function of the peroneus longus. This was clearly demonstrated in some of the early experiences with the procedure when the whole tendon of peroneus brevis was sacrificed, the remaining muscle was sutured to the peroneus longus. Subsequently the patients complained of painful sesamoids. Faculty members of the Institute believe that the preservation of a portion of the peroneus brevis is helpful in maintaining near normal mechanics of the foot and leg. This is a primary reason that the SPBLAS procedure is performed in preference to many others reported in the literature.

Chrisman, Snook, and Wilson noted that in returning to the surgical site of a previous lateral ankle stabilization for an unrelated fracture repair that there was actual hypertrophy of the remaining portion of the split tendon of peroneus brevis. A greater understanding of the healing properties of this tendon ligament complex is needed to adequately assess the long term success of the procedure.

Technique

The procedure starts with the patient placed in a lateral position on a vacuum pack with the knees bent. A pneumatic thigh tourniquet is utilized to facilitate hemostasis and decrease surgical and anesthetic time. Care is taken to insure that the contralateral extremity is well-padded at the level of the fibular head and lateral malleolus.

All relevant anatomic landmarks are identified and outlined with a skin scribe; base of the fifth metatarsal, distal one-third of the fibula, talus, and the body of the calcaneus (Fig. 3). Utilizing a piece of umbilical tape, the proposed course of the new tendon ligament is outlined by securing the tape at the base of the fifth metatarsal, placing it across the lateral aspect of the talus, posterior across the fibula, and down to the posterior body of the calcaneus. This is performed with the foot held at 90 degrees to the leg and the subtalar joint in its neutral position. This accurately measures the length of the tendon graft that will be required for the procedure.

The umbilical tape is used again by securing it at the base of the fifth metatarsal. The normal course of the peroneus brevis tendon is then traced proximally into the leg identifying the needed length of the proposed tendon graft. It also indicates the proximal extent of the incision (Fig. 4).

The skin incision is one of the most crucial parts of any surgical procedure. Prior to performing the skin incision, the target tissues and landmarks should be adequately identified with a marking pen. At the Institute, a single curvilinear hockeystick type incision is employed beginning 12 to 15 cm proximal to the lateral malleolus (Fig. 5) and extending distally to end proximal to the base of the fifth metatarsal. Care must be taken to insure that the target tissues; fifth metatarsal base, anterior margin of the distal one-third of the fibula, posterior body of the calcaneus, and the proximal tendon can now be accessed.

The skin incision is deepened through the subcutaneous tissue to the level of the deep fascia utilizing the concepts of the anatomic dissection (Fig. 6). Vessels are ligated as necessary to preserve hemostasis. Care is taken to protect the sural nerve throughout the procedure. The target tissues are identified with the superficial fascia reflected.

The deep fascia should remain intact along the length of the incision except at the target points. The split tendon will be passed from anterior to posterior through the fibula at approximately the level of the tibiotalar joint. Once the appropriate level is selected the deep fascia and periosteum are incised and reflected from anterior and posterior margins of the fibula. A small hand trephine is utilized to place a hole through the fibula from anterior to posterior approximately perpendicular to the long axis of the fibula. Serious complications may arise should the trephine fracture the medial or lateral cortex of the fibula, or damage the dome of the talus. At this point, it is quite helpful to identify the ankle joint with a freer elevator. Occasionally, an arthrotomy will be performed in conjunction with the procedure to inspect the articular surfaces of the talofibular joint and to reinforce the capsule and attenuated portions of the anterior talofibular and calcaneofibular ligaments.

The trephine plug should be preserved and utilized later in closure to stabilize the graft. As the trephine exits the posterior fibula at the peroneal groove, excessive force should be avoided to prevent splintering of the fibular cortex. The superficial fascia is retracted posteriorly while the posterior body of the calcaneus is identified. Care must be utilized to insure that the posterior subtalar joint is not penetrated. An incision through deep fascia and periosteum is performed at such a position as to simulate the calcaneofibular ligament direction. A corticocancellous trephine plug approximately 1.5 to 2.0 cm in depth is removed from the calcaneus and preserved.

Using the marked umbilical tape, the measurement is repeated to verify the length of needed tendon. The proximal level of the deep fascia and paratenon are then incised. The peroneus longus is retracted posteriorly to reveal the peroneus brevis tendon. Each tendon is isolated and functionally tested to insure identification. Recall that the peroneus brevis muscle is a bipenate structure and two contributions of muscle to form tendon, a superficial and deep portion. In our reconstructive procedure the

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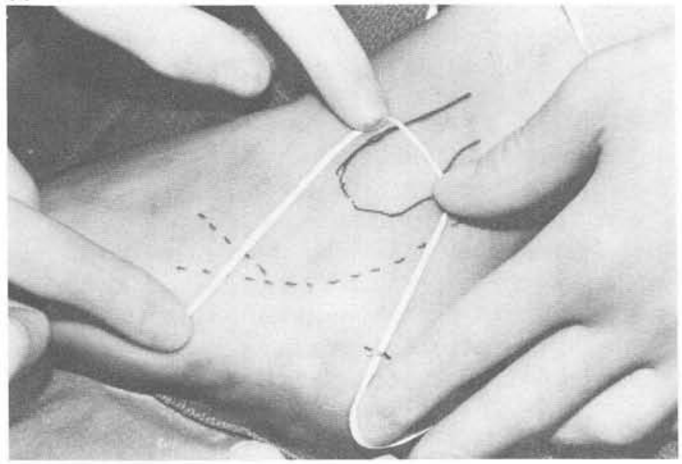

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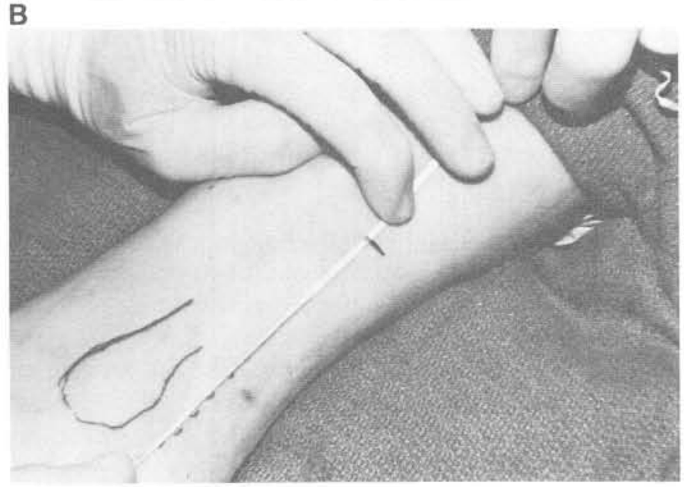


Fig. 4. The umbilical tape is used to determine the amount of tendon that will be needed for tendon-ligament graft. **A.** Outline of proposed tendon graft. **B.** Umbilical tape paralleling the course of the peroneus brevis tendon. The most proximal aspect of the tape assist in determing the most proximal portion of the incision.

Fig. 5. Skin incision. Note proximity to all target tissues.

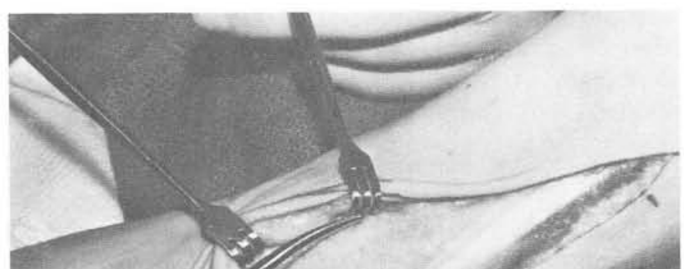


Fig. 6. Concept of anatomic dissection allows subcutaneous tissue to be reflected along deep fascia for easy access to target tissues.

superficial contribution is utilized. Harvesting the superficial portion of the tendon will facilitate an even split as we progress distally along the course of the tendon (Fig. 7).

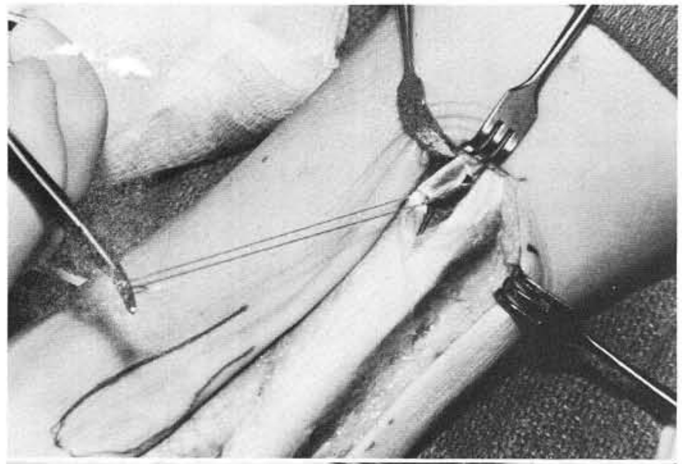
A 2-0 suture is utilized to tag the tendon. This piece of tagged tendon is passed beneath the fascia and tendon sheath along the course of the peroneus brevis tendon. It may become necessary to make a small incision in the peroneal retinaculum to facilitate the passage of the split tendon. A large Kelly hemostat or uterine packing forceps may be utilized. Once the tendon is harvested to the base of the fifth metatarsal, it is preserved in a moist saline sponge until its final routing (Fig. 8).

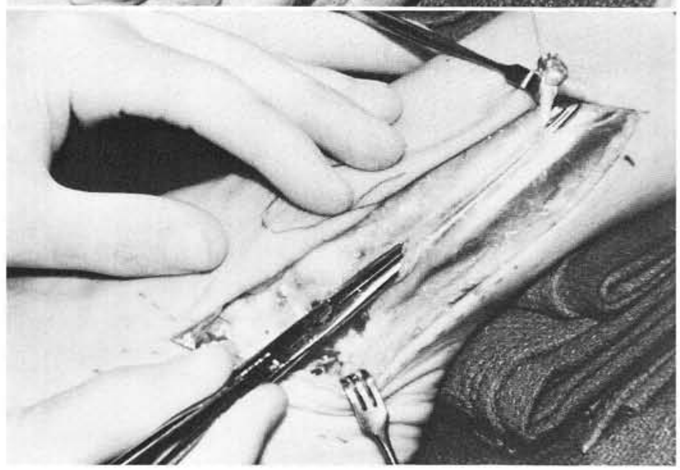
A unique feature of the SPBLAS procedure is that the split tendon is routed in a subperiosteal-subcapsular fashion. The subperiosteal-subcapsular channel is created from the base of the fifth metatarsal along the lateral aspect of the talus, exiting at the anterior margin of the fibula at the site of the trephine hole. Similarly, a channel is created in the posterior margin of the fibula to the calcaneal trephine hole.

The split tendon is then routed through the subperiosteal channels. At the anterior and posterior margins of the fibula, the tendon is secured with a 2-0 nonabsorbable suture to the periosteum and deep fascia in a figure-eight fashion. Once the tendon is secure, it is necessary for an assistant to hold the ankle at 90 degrees with the subtalar joint neutral. Proper tension is applied to the tendon graft while the bone plugs are replaced into the calcaneus and fibula and the tendon-periosteal junctions are then reinforced with a 2-0 absorbable suture.

The deep fascial incisions are then reapproximated with a 2-0 or 3-0 absorbable suture. A closed suction drain (TLS) is placed within the wound. Superficial fascia is reapproximated with a 3-0 or 4-0 suture with care taken to avoid the sural nerve. The skin is closed with either a 4-0 nonabsorbable subcuticular or a 5-0 absorbable subcuticular suture. Steri-strips are employed to decrease tension along the skin edges. Moist saline dressing sponges are utilized as a separator dressing and a Jones compression cast applied prior to the release of the tourniquet (Fig. 9).

Postoperative management consists of a Jones compression cast for the first three to five days following surgery. At that time, a dressing change is performed and the patient is placed in a below knee, non-weight-bearing cast for four weeks. This is followed by a two week period of a weight-bearing cast or a weight-bearing Bledsoe boot type device. After six weeks of casting, range of motion, use of high top shoegear with some compression is continued for another four to six weeks as the patient gradually returns to normal activity.





Evolutionary Modifications and Refinements

During the last ten years a number of changes have evolved. One change that has been most beneficial is the limited deep fascial incision. The deep fascia is now incised only at selected levels. In earlier years the deep fascia was opened along its entire course. The end result was a more edematous wound than is seen today.

The peroneal retinaculum is generally preserved during the SPBLAS procedure. If the retinaculum is damaged during the case or if it was injured from previous trauma, the tendon graft may be routed superficial to the tendons to simulate the retinaculum (Fig. 10). This differs from other published descriptions.

In many previous reports, power drills were utilized to effect the passage through the fibular and the opening into the calcaneus. We have found that hand trephines are easier to control and produce less damage to bone. The trephine preserves the bone plug for use in closure and offers an additive measure of fixation for tenodesis.

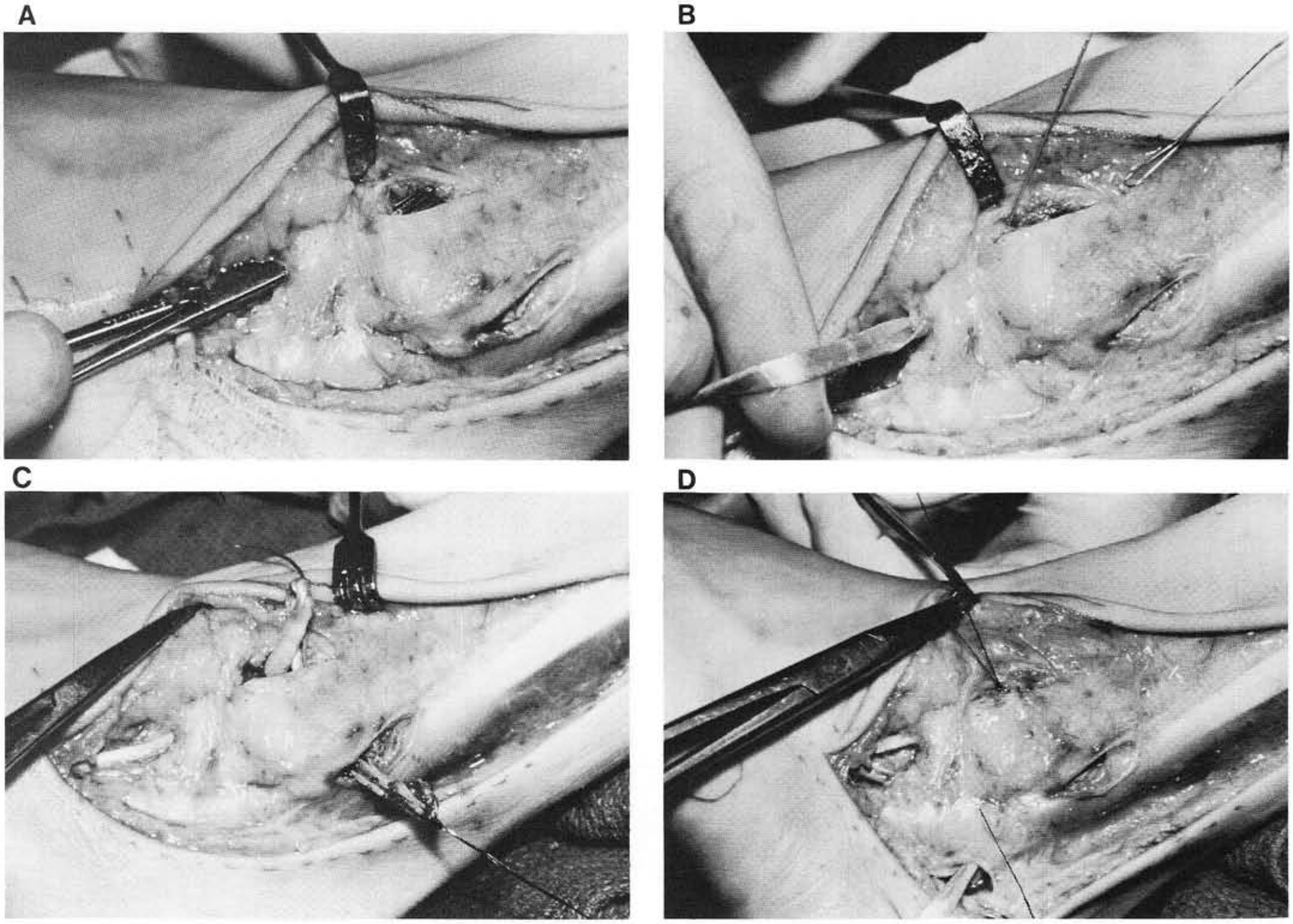


Fig. 8. The tendon graft is passed through trephine holes in fibula and along subperiosteal channels. A wire loop may greatly facilitate this procedure.

Routing the tendon-ligament complex in a subperiosteal channel affords greater stability to the lateral ankle. It may also contribute to stability of the subtalar joint and lateral aspect of the midtarsal joint.

Harvesting the graft has undergone a number of changes. In many of the initial procedures the whole tendon was harvested. In later cases the dorsal or lateral half of the superficial portion of tendon was split resulting in a harvest of 1/4 of the tendon. A number of cases in which the whole tendon was harvested, the peroneus brevis muscle was attached to the peroneus longus with a resultant increase in strength of the peroneus longus. As mentioned previously, a number of patients presented with complaints of sesamoid pain beneath the first metatarsal head due to the increased pull of the peroneus longus.

The use of umbilical tape as a measuring device has produced an increased accuracy in harvesting an adequate amount of tendon.

A drawback to our procedure is the lack of consistent ankle arthrotomy with inspection of joint surface and attenuated ligaments.

Complications

The literature cites a number of complications for the lateral ankle stabilization procedure. In the authors' view the most serious of these is continued instability. The incidence of continued instability is quite minimal, less than 10 percent, but even this is is too high. Other reported complications are transient dysthesias and paresthesias associated with the sural nerve. Postoperative sural nerve neuroma, painful hypertrophic scars, superficial wound slough, and deep infection are additional rare complications.

Another commonly reported complication is restricted motion at the ankle and subtalar joints. Occasionally, a patient will have decreased dorsiflexion at the ankle joint compared with the ankle prior to surgery as well as compared to the contralateral ankle. Painful limitation of the subtalar motion is often a result of the subtalar joint being held in strong eversion when the tendon ligament was sutured into place. One case necessitated a release of the excessive tightness which then resulted in satisfactory function. Another rare occurrence has been hypertrophy of the peroneal tubercle on the lateral aspect of the calcaneus requiring further surgery and remodeling.

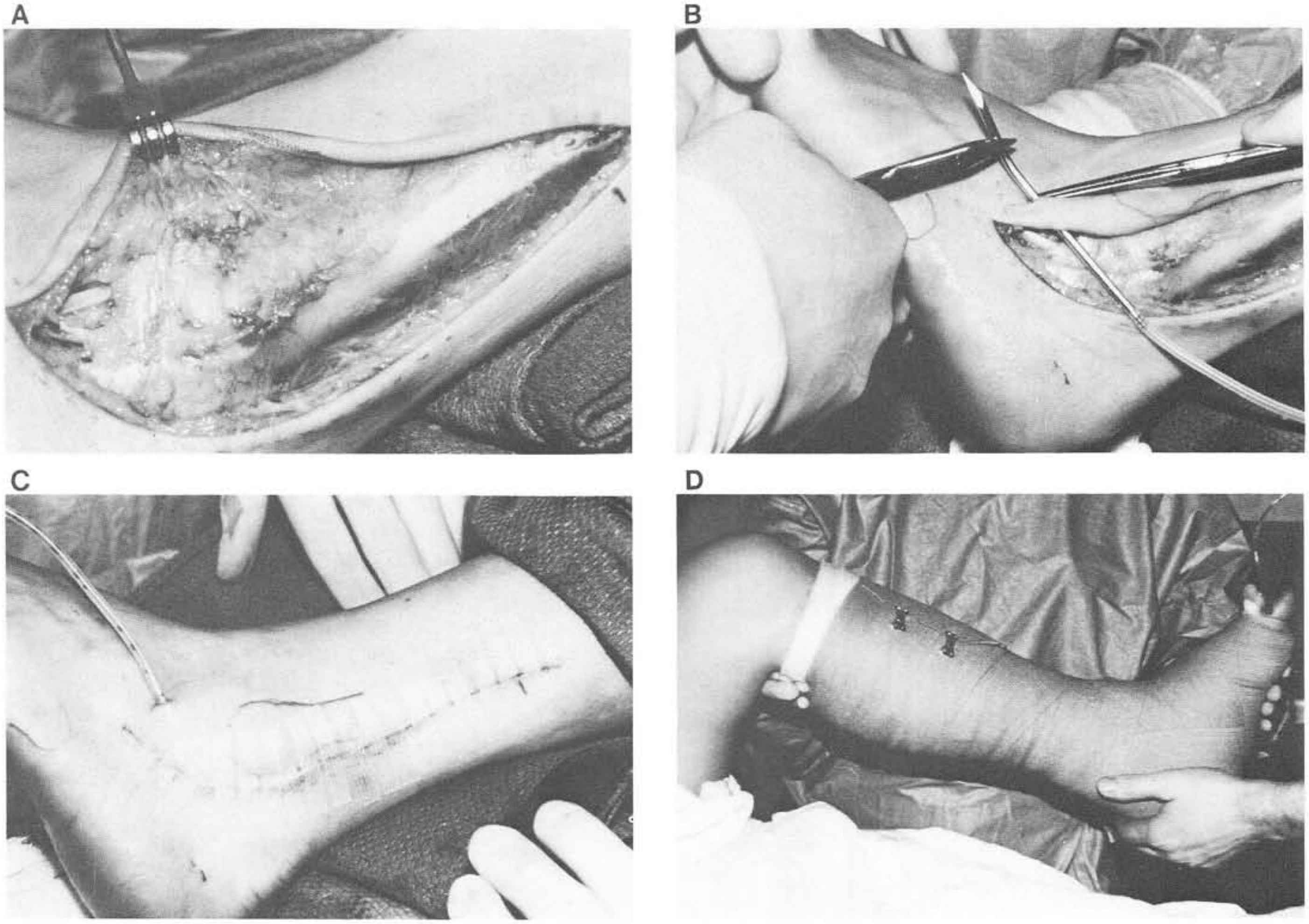


Fig. 9. Wound closure is in layers. Closed suction drain is employed for first 48-72 hours.

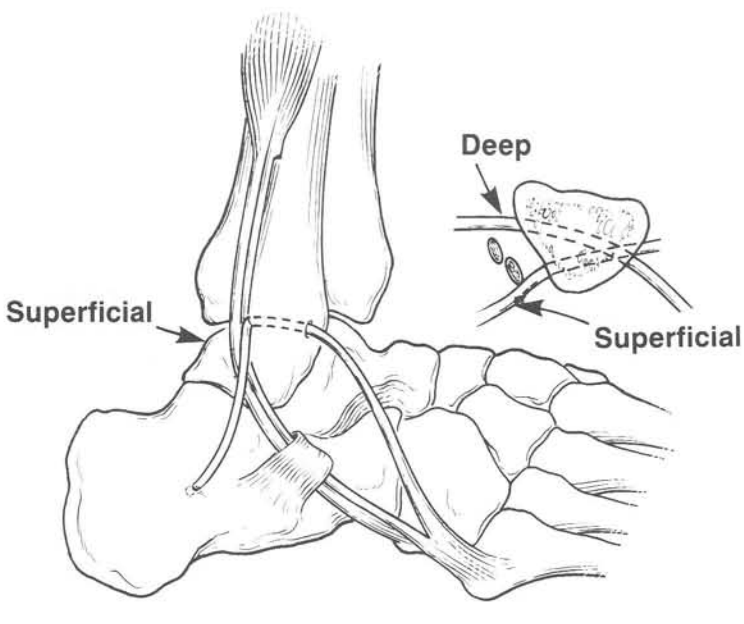


Fig. 10. Split peroneus brevis tendon can be transferred superficially or deep to peroneus longus and brevis tendons depending on location of fibular trephine hole and integrity of peroneal retinaculae.

Proposed Study

At the time of this writing a retrospective study is being performed at the Institute. The majority of the patients have had the procedures performed by or under the supervision of one of the authors. Patients are undergoing a physical examination with followup standard and stress radiographs. In addition they are also filling out a questionnaire regarding:

1. The activity level prior to surgery.
2. Duration of symptoms prior to surgery.
3. Present activity level.
4. Recurrence of instability of the ankle.
5. Any loss of motion or joint stiffness.
6. Pain or numbness associated with palpation of the outside of the foot and ankle.
7. Any modification of activities in surgery.
8. The use of an ankle brace.

Our criteria for satisfactory reconstruction is quite similar to that utilized by Chrisman, Snook, and Wilson:

1. A limitation of ankle instability
   A. Objectively
   B. Subjectively
2. Return to occupational and recreational activity.
3. Restoration of normal and near normal ankle and subtalar motion and foot function.
4. Normal or near normal sensory perception.

Future Considerations

The advent of synthetic material such as carbon fiber, and Gore-Tex may prove to be very useful for stabilization or to supplement atrophied or attenuated ligaments. Experimental work with these various materials is bringing new insight to the healing properties of tendon grafts and ligaments.

Summary

The SPBLAS procedure is a proven procedure that is utilized for repair of the chronic recurrent unstable ankle that may result from a neglected grade III ligamentous disruption or when there has been recurrence of instability to a previously repaired lateral ankle. A high percentage of satisfactory results can be expected and good ankle function restored.

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