CHAPTER **49**

REVIEW OF GUIDELINES FOR LOWER EXTREMITY TENDON TRANSFERS

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INTRODUCTION

The goal of any lower extremity tendon transfer is to create a stable, functioning, and plantigrade foot.[1] In essence, a tendon transfer procedure relocates the insertion of a functioning muscle-tendon unit to restore lost movement and function at another site.[2] These procedures were first reported in the nineteenth century as a result of polio epidemics in Europe and were devised to improve ambulation in polio patients with varying degrees of paralysis. It was not until after World War I and II, which resulted in large groups of patients with upper extremity injuries, that tendon transfer procedures were used and refined in the upper extremity as well.[3] There are many indications for lower extremity tendon transfer procedures to be performed. These include trauma, neuropathy, tumor, spinal cord injuries, muscular dystrophy, and tendon ruptures.

Principles for tendon transfers have been described and refined over the past century for both upper and lower extremity tendon transfers. Even though these principles overlap for both the upper and lower extremity, there are differences and specific principles or guidelines for lower extremity tendon transfers can be outlined for surgeons considering these procedures.

PREOPERATIVE EVALUATION AND PATIENT SELECTION

During the preoperative evaluation there are many factors concerning the patient's underlying pathology or etiology that can impede or dictate a successful tendon transfer. The clinician must first establish whether or not the patients disablement is a static, progressive, flaccid, or flexible deformity. It is also very important to establish a baseline motor evaluation of the patient. Depending on the etiology of the disablement, the clinician must try to maintain function and prevent further deformity of the foot preoperatively. Initiating a preoperative muscle strengthening program is another valuable tool to be utilized.

Supple Joints Upon Which the Tendon Transfer Will Act

The joint at which a tendon transfer will act must have a maximum passive range of motion to be successful.[2] The deformity must be flexible for the transfer to be effective and if the deformity is fixed it must be corrected at a prior surgery or within the same operation.[4] Such fixed deformities can be altered by joint releases, tendon lengthening, osteotomies and arthrodesis.[4]

Soft Tissue Evaluation

A careful evaluation of the soft tissue bed through which a tendon is transferred must be performed. The goal is to choose a healthy bed of tissue that is void of inflammation, edema, and scar tissue.[2] The selection of an appropriate bed of tissue combined with atraumatic dissection technique will minimize adhesions and allow the tendon to glide freely.

Expandability, Adequate Strength, and Excursion of the Transferred Tendon

When choosing an adequate muscle-tendon unit to be transferred, the clinician must make sure that the unit is expendable. This means that there must be another remaining muscle-tendon unit that can continue to adequately perform the donor unit's original function.[2] Next, the muscle-tendon unit needs to be evaluated for adequate strength. A muscle-tendon unit should have a grade of 4/5 or better; this rule is especially true seeing that most tendons lose one grade of power after being transferred.[1] During evaluation of the donor unit, it is easiest to compare the unit's relative strength as opposed to its absolute strength.[5] In 1985 Silver et al determined the relative strength of the muscles that cross the ankle joint and those results can be a useful comparison in a clinician's initial baseline evaluation. Finally, the donor muscle-tendon unit should have an adequate excursion. In essence, the donor unit should have an excursion similar to the tendon it is replacing to achieve the desired function.[1,2,4]

Line of Pull and Angulation of the Transferred Tendon

In order for the transferred tendon to achieve maximum physiologic efficacy it needs to be positioned in a straight line of pull and with minimal non-anatomic angulation.[1,4] An increase in angulation and a line of pull that is not straight, causes a decrease in the amplitude and the vector forces governing the tendon's effectiveness.

TENSIONING AND ATTACHMENT OF THE TRANSFERRED TENDON

The amount of tension set on the transferred tendon should correspond to the normal physiologic conditions under which the muscle and tendon work.[4] Even though excessive tensioning of a tendon can result in degeneration of tendon, many authors have suggested to tension a tendon too aggressive rather than too passive.[1,2,4] The tendon transfer junction tends to relax and lengthen postoperatively, and a transfer that is set with inadequate tension will not improve.[1]

A tendon can be attached in one of three ways: tendon to tendon, tendon to bone, and tendon to periosteum.[4] Jeng et al advocate that tendons should be fixed to bone if possible because it allows direct action of the tendon on the skeletal structures without a soft tissue intermediary. When attaching a tendon to a soft tissue intermediary, attention should be made to underlying conditions such as tendinopathy, atrophy or other progressive neuromuscular diseases affecting the soft tissue.

Perferably Transfer In Phase

The muscle-tendon units controlling the foot and ankle can generally be categorized as having activity in either the swing phase or stance phase of the gait cycle. It is preferable to transfer a tendon where its new function is in phase with its existing function. A phasic tendon transfer commonly requires less postoperative rehabilitation and is less likely to endure strength loss. In 1955 Close and Todd evaluated the ability of a transferred muscle-tendon unit to change phase and found that muscle-tendon units transferred in phase would return to functional activity more rapidly then if transferred out of phase. A phasic tendon transfer is always preferable, although a non-phasic transfer is sometimes the only available option.[1,2,4]

Atraumatic Dissection Technique

Atraumatic dissection technique is essential in preserving the gliding function of the transferred tendon. Meticulous planning allows the surgeon to minimize adhesions and protect the gliding surfaces of the transferred muscle-tendon unit. Care must be given to appropriate incision placement, hemostasis, and handling techniques of the tendon.

Postoperative Management

A carefully planned postoperative program is essential to achieve favorable outcomes for tendon transfers. Postoperative care for these procedures needs to consist of a period of immobilization followed by a structured rehabilitation/strengthening program. The goal of immobilization is to protect the transferred tendon until appropriate healing has been achieved. The surgeon must be careful because a prolonged period of immobilization could result in adhesions and restrictions of the transferred tendon, and prematurely starting a rigorous rehabilitation program could result in a rupture or attenuation of the transferred tendon. A delicate balance lies between when to transition a patient from a period of immobilization into a gentle rehabilitation program.

CONCLUSION

The perioperative management of tendon transfers can be intimidating and overwhelming. When planning this type of surgery a structured perioperative plan should to be laid out. This plan needs to include a thorough preoperative evaluation, appropriate patient selection, pre and post-operative rehabilitation programs, and realistic pre and postoperative expectations. Even though tendon transfers can be very detailed orientated, they can also be very rewarding for both the physician and patient when they are approached in a systematic order.

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