Modification of Tendon Transfer Surgery for Radial Nerve Palsy due to Pre-operatively Observed, Unexpected Partial Return of Wrist Extension

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ABSTRACT

Herein we present the case of a 78-year-old female who suffered a radial nerve injury following her third left shoulder arthroplasty. At first follow-up two and a half weeks following shoulder surgery, she presented with left arm weakness and profound, persistent hand weakness. This was diagnosed as complete radial nerve palsy. After three months, the patient still had no return of function. At that point, she became a candidate for tendon transfer surgery to remediate her complete radial nerve palsy. At six months post-arthroplasty, it was noted on exam that she unexpectedly regained weak wrist extension two weeks before her scheduled three tendon transfer surgery. The decision was made to proceed with a modified two tendon transfer procedure. Surgery is the most reliable treatment to restore function, but it must be tailored for each patient’s specific needs. A current assessment of the patient’s reconstructive needs must be performed to prevent overtreatment.

INTRODUCTION

Neurologic injury after shoulder arthroplasty is a relatively uncommon occurrence, complicating only 4% of cases in one study. Of those cases, 88% went on to report a point of maximum improvement. This subset of patients who experience iatrogenic radial nerve palsy and who do not experience recovery of function with conservative treatment are candidates for wrist, thumb, and finger extension reconstruction. Surgical evaluation should include physical examination with electrodagnostic studies (nerve conduction study and needle electromyography). Considering the extent to which activities of daily life are compromised as a result of impaired grip, tendon transfer surgery is a reasonable course of treatment despite the technical challenges of such a procedure. Before undertaking a complete surgical remediation of radial nerve innervated extension, functional deficits should be monitored and characterized up to the point of surgery with the goal of surgically intervening up to, but not beyond, what the case requires.
A 78-year-old female was referred for evaluation of a radial nerve palsy that failed to resolve five months after shoulder surgery. The patient presented with inability to extend the left fingers, thumb, and wrist; there was no weakness with elbow extension. Sensory response was present in the first dorsal webspace. Her medical history included bilateral carpal tunnel syndrome, treated surgically, a cervical spinal fusion and three separate shoulder arthrodesis procedures (left humeral arthroplasty and left partial removal of prosthesis in 2006, left revision arthroplasty in 2012). Physical exam showed left radial nerve deficits with inability to supinate the hand or extend the fingers, thumb, and wrist (Video 1).

Further examination revealed normal median nerve innervation with a powerful palmaris longus, flexor carpi radialis, flexor carpi ulnaris, and palpable contraction of the pronator teres. The patient’s right upper extremity was normal. A post-arthroplasty electromyography and nerve conduction study was done three months after shoulder surgery, which was two months before initial presentation. It demonstrated profound denervational changes in radial nerve innervated muscles. Extensor indicis proprius and extensor digitorum communis showed 4+ fibrillations and 4+ positive sharp waves along with no recruitment activity. The median nerve innervated muscles, the abductor pollicis brevis and pronator teres, were normal. Triceps and deltoids were also normal. A tendon transfer operation was recommended to move palmaris longus (PL) to extensor pollicus longus (EPL), flexor carpi radialis (FCR) to extensor digitorum communis (EDC), and pronator teres (PT) to extensor carpi radialis brevis (ECRB). Electrical studies were repeated one week after presentation and were consistent with earlier results. Surgery was scheduled for five weeks later.

Three weeks after initial presentation and two weeks prior to surgery, the patient was re-examined and observed to have a spontaneous return of ability to extend the wrist with some radial deviation.

In light of this very unusual development, the surgeon decided to forego the PT to ECRB transfer, proceeding instead with a two tendon, modified Tsuge technique. Splinting was done with a palmar thumb spica splint with the wrist extended to thirty degrees and the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal joints in zero degrees with the thumb held in maximal extension and palmar abduction. Post-operative rehabilitation was required for three months. At six months following tendon transfer, the patient had regained excellent functionality in the radial nerve distribution with active wrist extension maintained against gravity (4/5) and active finger extension assisted by a tenodesis effect of her tendon transfers (Video 2).

CASE PRESENTATION


Video 2. Inability to extend wrist. Available at: http://www.amsrj.org/public/journals/1/articlevideos/180-666-1-SP.wmv

BRIEF REPORTS

MODIFICATION OF TENDON TRANSFER
DISCUSSION

Our case of radial nerve injury and recovery is quite unusual. The anatomical course of the nerve makes it susceptible to lesions. Originating from the posterior cord of the brachial plexus, it travels snuggly along the humerus in the spiral groove before continuing distally. The likelihood of nerve injury is elevated in this region due to high nerve tension and the spiraling course of the nerve. Lesions can include rupture, neurapraxia, axonotmesis, and neurotmesis. Most radial nerve damage suffered intraoperatively turns out to be neurapraxic. By definition, these patients experience complete recovery in three months. In cases of more severe, unresolved nerve palsy, other modes of injury are present with or without concomitant neurapraxia. Spontaneous recovery is very unusual; our case demonstrates an exceptional instance of late recovery. More severe injuries, like the one presented here, have very low probability of recovery and require surgery as the ultimate treatment. Direct repair of the nerve is uncommon; one group’s experience showed only 44 surgical radial nerve repairs in 22 years at a large tertiary care center. Because most radial nerve lesions are not directly repaired via nerve surgery, tendon transfer is the most common treatment. For these patients, further consultation by a hand surgeon is necessary.

The most important aspect of caring for patients with these injuries is to conduct a thorough physical examination. Establishing a new baseline clinical functionality, after the onset of nerve palsy but before treatment, will be essential in monitoring recovery progression. It is the responsibility of the physician to ensure accurate, current physical exam information. This becomes even more crucial in cases of invasive treatment when the threat of overtreatment becomes more likely. Once the clinician has fully explored the lesion, a variety of treatment options are available.

The medical literature sparsely covers surgical overtreatment. Many of these publications focus on abdominal surgery. Popular media outlets, such as healthcare and news websites, cover this topic narrowly, predominantly discussing breast and prostate surgeries. Overtreatment via surgery leads to increased spending and could lead to increased morbidity associated with potentially unnecessary procedures. Some authors have even suggested that overuse of medical treatment can lead to overuse of surgical treatment in a given patient, which may compound the deleterious effects of surgical overtreatment.

For cases similar to the one presented here, conservative treatment could begin with rehabilitation and splinting. Patients can expect mild improvement. A literature search performed in November 2014 reveals no cases of symptom resolution using splinting and therapy alone. Pharmacological treatment can be used to treat neuropathic pain from a lesion but cannot repair functional loss. Surgical treatment is indicated as the best treatment option for restoration of function. One surgical approach is to repair the radial nerve with a nerve graft. One study suggested that 72% of patients treated by nerve grafting experienced some return of function. Despite this, nerve repair requires exact localization of a nerve lesion, which is often impractical, as in this case. Tendon transfer surgery should also be considered. This is a reliable operation for functional improvement. Results are generally excellent and, in contrast to non-operative treatment, multiple studies have shown successful outcomes.

Surgery must be carefully discussed with the patient. In cases of iatrogenic radial nerve palsy, the patient may not be entirely enthusiastic about the prospects of another surgery. More-
over, while results are generally good, some variation does exist and this can depend on the skill of the surgeon and the tendon transfer technique employed. Possible complications include tendon adhesions, transfer rupture, tendon weakness, and infection.\textsuperscript{14} Recovery also requires determination on the part of the patient, with an expected recovery time of about six months. Tendon re-education is essential to regaining maximal extensor functionality; some people will accomplish this through cortical ‘trial and error’, in which the motor cortex slowly reassigns neurons, while others may require occupational therapy.\textsuperscript{9,11} Further, it is absolutely essential that the surgeon continually reassess the patient’s hand extensor functionality. As we presented above, a patient can spontaneously recover certain functional aspects. It is the responsibility of the surgeon to recognize progressive recovery, appropriately tailor the surgical technique, and prevent overtreatment.

In the case presented here, we display how diligent attention to physical exam can prevent overtreatment in surgery; this helped avoid the pitfalls mentioned earlier. By continually reassessing the patient, especially in the weeks leading to surgery, critical observations were made that fundamentally altered the patient’s surgical needs. On the other hand, physicians must remain open-minded in regard to altering treatment plans based on new exam findings. Willingness to accept changes in the immediate pre-operative time period is as important to the prevention of overtreatment as continually updating the clinical assessment. In our case, slight recovery was observed and the finding was treated as significant. Flexibility on the part of the surgeon is required for translating real-time clinical progress into real-time surgical plans. This translation occurs best when up-to-date clinical observation acts synergistically with flexible pre-operative planning. In this context, the risk of surgical overtreatment can be effectively and efficiently mitigated.

Surgeons can easily adopt this virtually costless practice to work towards preventing overtreatment of their patients. We have not attempted to quantify the magnitude of this positive effect, the extent to which surgical patients are overtreated (intra- or peri-operatively) or the specific benefits of this approach for generalized tendon transfer procedures. Future research in these directions will be necessary to complement this case report and to fully comprehend the often-overlooked concern of overtreatment with surgery.

LEARNING POINTS

1. Surgeons must be diligent about continuously reassessing patients and tailoring a surgical treatment plan based on new findings.

2. Overtreatment can be avoided with conscientious clinical examination.

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