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TOTAL ELBOW ARTHROPLASTY REPORT

ABSTRACT

The surgical and therapeutic management for total elbow arthroplasty is reviewed. Surgical overview and techniques, stability issues, factors affecting therapy, and a proposed postoperative treatment plan are presented (M. Szekeres 2006).

INTRODUCTION

The elbow is frequently involved in many diseases, most notably, rheumatoid arthritis, but it is also affected by other inflammatory arthropathies, primary degenerative osteoarthritis, hemophilia, and sepsis. Fractures about the elbow account for 7% of all adult fractures, and after the shoulder, the elbow is the second most frequently dislocated joint (S.D. Trigg, 2006).

Surgical intervention is normally recommended for elbow joints with severe rheumatoid arthritis. The goal of total elbow arthroplasty (TEA) is to restore functional mechanics to the joint by removing scar tissue, balancing muscles, and inserting a joint replacement in the place of the destroyed elbow (Cuong Pho). TEA has proven to be a reliable joint replacement procedure that has a high degree of patient satisfaction (S.D. Trigg, 2006).

TYPES OF IMPLANTS USED

In 1972, Dee and Sweetnam were the first to report the use of total elbow arthroplasty (M. Szekeres 2006). Modern TEA implants fall into two design categories, linked and unlinked. These terms are generally interchangeable with the descriptors semi-constrained and unconstrained, respectively (S.D. Trigg, 2006). Semi-constrained prostheses have a "loose-hinge" mechanical linkage that more accurately replicates the kinematics of the native elbow. An anterior flange accompanies the humeral component of many linked designs in an effort to resist the posterior and rotational displacement forces thought to contribute to early humeral loosening (M. Szekeres 2006).

Both linked and unlinked TEA implants have yielded similar functional outcome and patient satisfaction scores. However, because of the inherent differences in stability, the linked and unlinked designs have different indications. The unlinked designs require competent soft tissue constraints and adequate bone stock length to yield a stable arthroplasty; therefore, their use is often limited to or preferred when there is less bone or articular destruction. Moreover, as less bone is removed to implant the resurfacing unlinked prosthesis, it may be preferred in younger patients who may need later revision surgery (S.D. Trigg, 2006). Patients with insufficient bone stock, advanced osseous deformity, gross instability, or capsulo-ligamentous insufficiency are poor candidates for unlinked arthroplasty (M. Szekeres 2006).

Linked prostheses are indicated when significant bone or ligamentous deficiency exists. Aseptic loosening and bearing wear are primary causes of failure, especially in younger patients. Linked arthroplasty should therefore be performed reluctantly in patients under

65 years of age, in those who demand continued heavy use of the limb, and in those who are unable to comply with the postoperative rehabilitation program.

Good results have been reported after total elbow arthroplasty for both linked and unlinked designs. Patient satisfaction and implant survival approaches that of hip and knee arthroplasty in the rheumatoid population (M. Szekeres 2006).

INDICATIONS AND CONTRAINDICATIONS

Total elbow arthroplasty, whether linked or unlinked, is the most definitive functional procedure for end-stage elbow arthritis. Common indications for total elbow arthroplasty are severe pain due to degenerative joint disease such as end stage rheumatoid arthritis or osteoarthritis, progressive loss of functional range of movement and instability of elbow joint and trauma e.g. flail elbow or non-union of supracondylar fractures (Wheeless, 2009).

Absolute contraindications for TEA include active or recent sepsis, an inadequate soft tissue envelope, a neuropathic elbow joint, flaccid paralysis of the upper extremity and nonrestorable function of the biceps and triceps. Poor patient compliance with activity and weight-lifting restrictions is also an absolute contraindication for surgery (Wheeless, 2009).

REHABILITATION

The role of the therapist should be to provide some limited hands-on treatment and more importantly to provide education to patients regarding oedema control, splint use, home exercise programs, and scar management. The therapist should also identify precautions associated with the surgical procedure and outline the functional restrictions that patients should follow (M. Szekeres 2006).

Therapists should be aware of several factors that will affect postoperative management and rehabilitation. These include the type of implant used, the status of the triceps tendon, the overall stability assessed in the operating room, and the status of the ulnar nerve (M. Szekeres 2006).

Type of implant used:

Rehabilitation varies based on the type of implant used in surgery. The semi-constrained elbow prosthesis does not require significant ligamentous support. For this reason, the elbow tends to be more stable postoperatively and therapy can proceed without the need to restrict extension or follow as strict a postoperative precaution regime (J. Sayles, 2007).

With the non-constrained elbow prosthesis, elbow extension range of motion is restricted from extending past 40 degrees initially and this is increased by 10 degrees per week until the patient has regained functional extension range of motion (M. Szekeres 2006). Combined elbow extension and supination is contraindicated for a minimum of six postoperative weeks, due to the stress on the lateral soft tissue repair. In addition, these patients should not perform any shoulder/elbow exercises and/or functional activities in shoulder abduction, as this position will generate stress on the lateral collateral ligament of the reconstructed elbow (J. Sayles, 2007).

Regardless of the type of implant used, active forearm pronation and supination exercises are performed with the elbow in at least 90 degrees of flexion to protect the repair of the collateral ligaments (M. Szekeres 2006).

Triceps involvement

Adequate exposure of the ulno-humeral joint in surgery can be achieved by reflecting the triceps off its insertion or by a triceps-sparing approach.

If the tendon is reflected in surgery and then reattached to its insertion following implant placement, it must be protected postoperatively. Patients are instructed to perform gravity-assisted extension exercises for at least four weeks following surgery to avoid strong triceps contraction. Patients can progress range of motion and work on gently strengthening the muscle until they are able to return to full activity after 12 weeks including pushing up from a chair and using a walker. Flexion must also be monitored closely in patients who have had triceps reflected and repaired in the operating room. There is the potential of triceps rupture of the repair if patients are too aggressive with flexion, thus leading to tricep insufficiency. However, this tricep insufficiency is less than 2% after total elbow arthroplasty (M. Szekeres 2006).

With the triceps-sparing approach, no postoperative protection of the triceps is needed. This approach allows patients to initiate active elbow extension immediately post-op without fear of gapping or rupture. This is the preferred technique because it likely limits atrophy of the muscle and limits adhesions (M. Szekeres 2006).

Ulnar nerve status:

Management of the ulnar nerve during total elbow arthroplasty is controversial. Some surgeons do not expose the nerve during the operation. Others expose the nerve and perform an anterior ulnar nerve transposition. Therapists need to be aware of the status of the ulnar nerve as it can pose problems during rehabilitation if not transposed at the time of surgery. For those who undergo arthroplasty due to arthritis, elbow flexion can potentially be increased at the time of surgery. If the ulnar nerve remains in its anatomical position, regaining flexion after surgery can cause compression of the nerve. Patients need to be cautioned that if prolonged passive flexion or static progressive flexion splinting causes paresthesia, they must discontinue the flexed position immediately to prevent ulnar nerve compression (M. Szekeres 2006).

Postoperative care:

Patient referral is delayed for two to three days to allow for early wound healing prior to initiating elbow motion. They are fitted with the appropriate splints and then educated on oedema control techniques (icing, elevation, and/or compression), and their home exercise programs are reviewed. The exercises vary depending on the type of prosthesis, triceps status, and overall stability as outlined in previous sections. At two weeks post-op, sutures are removed and patients begin scar massage once the wound is fully closed. Patients then begin superficial heat modalities prior to exercises to increase tissue extensibility and the effectiveness of stretching as long as oedema has decreased sufficiently. Heat also helps decrease co-contraction of the muscles crossing the elbow, which can be a significant obstacle to increasing range of motion. Gentle passive stretching can begin for both flexion and extension around weeks seven to eight if a

functional arc of motion has not been achieved, and even as early as week six in the event of a very stiff elbow. Static progressive splinting can also be initiated at this time, but this is rarely required. Gentle strengthening exercises within weight limit restrictions of 2 kg can begin at ten weeks and are mainly aimed at improving triceps function. A focus on triceps strengthening is important if the triceps required protection during the early postoperative period as this often leads to weakness and potential adhesion (M. Szekeres 2006).

POSTOPERATIVE SPLINTING

Splinting following total elbow arthroplasty varies depending on the type of prosthesis used. Linked arthroplasties are inherently more stable than unlinked designs. Daytime use of a collar and cuff is prescribed for linked arthroplasties that have had a triceps-sparing approach or for low-demand patients who will place less stress on the replacement. The collar and cuff is worn at all times except during very light activities of daily living, for exercises, and while sleeping. Unlinked arthroplasties often require greater protection postoperatively, and these patients are fitted with a prefabricated posterior elbow splint holding the elbow in 90 degrees of flexion. However, allowing the capsule of the elbow to remodel itself while the elbow is flexed can potentially lead to increased swelling and the development of flexion contractures. Patients therefore remove the splint frequently during the day for exercise sessions (M. Szekeres 2006).

An extension splint is beneficial because it reduces tension on the surgical incision. The selection of an extension splint for patients with unlinked arthroplasty depends on ligamentous stability. If stability is in question, patients wear the prefabricated flexion splint at all times and work on extension to the limit set by the therapist (M. Szekeres 2006).

SUMMARY

The success of any procedure is largely dependent on providing a sustained relief of symptoms and on the avoidance of complications. Elbow arthroplasty has historically been plagued by a high rate of complications. While some complications, such as intraoperative fracture, wound breakdown, deep sepsis, triceps insufficiency, and ulnar neuropathy, are inherent in most elbow arthroplasty procedures, other complications are specific to implant design. Linked arthroplasty is more frequently associated with aseptic loosening and mechanical failure, while unlinked designs are more prone to instability (M. Szekeres 2006).

Despite the complications that can occur with total elbow arthroplasty, it has become a primary choice for the treatment of low-demand patients with complex fractures or advanced elbow arthritis. Physical therapy can play an important role in postoperative management of total elbow arthroplasty. Communication between the surgeon and therapist is essential because management varies depending on the type of prosthesis used, the status of the ulnar nerve, intraoperative management of the triceps, and overall stability assessed in the operating room. If therapists are aware of these factors prior to initiating treatment and provide appropriate splinting, exercise programs, and patient education, complications will be minimized and success can be achieved in the rehabilitation of total elbow arthroplasty (M. Szekeres 2006).

TOTAL ELBOW ARTHROPLASTY PROTOCOL

PRE-OPERATIVE

- Assessment as appropriate, to include neck, scapula, shoulder, wrist and hand range of movement, muscle strength, elbow stability and general upper limb function.
- Instruct in application of ice and encourage use as much as tolerated within a 24 hour period for first week. If using ice packs, encourage to ice 20-30 minutes every 3-4 hours while awake.
- Instruct in home program of elbow flexion, extension, pronation and supination.
- Instruct in basic progression of rehabilitation program and expectations for time course to recovery
- Arrange follow-up physical therapy appointment on 7th-10th day post-op to correspond with physician's post-operative evaluation (Cuong Pho)

Rehabilitation Considerations:

- Hematoma formation following elbow arthroplasty increases the risk of infection and can lead to pain and loss of motion in the early phases after surgery, thus, reducing and mobilizing oedema are critical in the early phases.
- Full flexion and extension can usually be obtained on the table but stiffness may occur rapidly therefore, patients must be encouraged to perform daily stretching exercises to preserve motion.
- Because the extensor mechanism must heal back to the ulna, active elbow extension, such as using the arm to assist in rising from a chair, is not permitted for 8 weeks.
- Adjacent joint therapy may be particularly important for patients with rheumatoid arthritis who may have concomitant disease of the shoulder and wrist (Seacoast Orthopaedics)

PHASE I – IMMEDIATE POST SURGICAL PHASE:

Post Surgical Considerations:

- Risk of infection
- Joint dislocation
- Prosthetic loosening (Cuong Pho)

Phase I Goals:

- Allow healing of soft tissue.
- Maintain integrity of replaced joint and ligamentous reconstruction (if applicable).
- Gradually restore active range of motion (AROM) of cervical spine, shoulder/wrist/hand as indicated.
- Gradually increase active assisted range of motion (AAROM) of the elbow and forearm.
- Reduce/minimize pain and inflammation.

- Regain independence with activities of daily living (ADLs) with modifications. (J. Sayles, 2007)

Phase I Precautions:

- Elbow is positioned in a soft posterior elbow splint at about 60 degrees of flexion, unless otherwise specified. A sling is used for comfort only.
- Therapists should assess for signs of ulnar neuropathy during the rehabilitation process and alert the orthopaedic team if present.
- Avoid combined elbow extension and supination ROM for patients with a non-constrained resurfacing procedure.
- Patients who have undergone a resurfacing procedure should not perform any shoulder/elbow exercises and/or functional activities in shoulder abduction as this position will generate stress across the lateral collateral ligament of the elbow.
- No lifting of objects greater than 1 lb. with operated upper extremity.
- No excessive stretching or sudden movements (particularly extension).
- Avoid varus/valgus stress to the elbow (i.e. avoid excessive reaching across the body with ADLs).
- No upper extremity weight bearing with the involved side. No assistive device for ambulation should be used with operative upper extremity. No upper extremity pushing motions against resistance.
- No soaking for 2 weeks, or until staples/sutures are removed and incision is dry and intact. (J. Sayles, 2007)

Early Phase I: (Post-operative day 1-7)

- AROM cervical spine, shoulder, wrist, and hand.
- Gentle AAROM elbow extension and flexion exercises initiated with elbow held close to the body (adducted position) with forearm in neutral to pronation bias.
- Gentle AAROM supination and pronation exercises initiated with elbow held close to the body. Unless otherwise instructed, forearm rotations are to be completed with the elbow held at the side at 90 degrees of flexion to minimize strain on ligamentous structures.
- Gentle gravity-assisted elbow extension stretching to enhance extension ROM.
- Frequent cryotherapy for pain, swelling, and inflammation management.
- Compressive wrapping/garments for oedema management as indicated.
- Patient education regarding proper positioning, ROM precautions, joint protection techniques, and ADLs. (J. Sayles, 2007)
- Instruct in home program, and begin, active assisted elbow and wrist flexion, extension, pronation and supination
- Instruct in home program, and begin, self-assisted forward elevation and external rotation of the shoulder to prevent adjacent joint stiffness
- Finger ROM but no aggressive grip strengthening so that muscular attachments heal (Seacoast Orthopaedics)

Late Phase I: (Post-operative day 8 thru post-operative week 6):

- Patients are typically weaned out of the elbow splint for daytime use during their second postoperative week, unless otherwise specified. The splint is typically worn only at night and during high-risk activity (J. Sayles, 2007)
- AAROM/AROM elbow extension, flexion, supination, and pronation to tolerance.
 - No combined extension and supination for those with non-constrained resurfacing procedure.
 - Progress to supination/ pronation exercises with elbow held at side at 90 degrees to minimize strain on ligamentous structures.
 - Elbow extension should not be forced at any stage of rehabilitation (Little et al, 2005), and average elbow range of movement following elbow arthroplasty is limited to 35° to 135° (South Australian Orthopaedic Registrar' Notebook, 2009).
- Continue cryotherapy and oedema management as needed for pain and inflammation.
- Scar management upon suture/staple removal. (J. Sayles, 2007)
- Progress to active assisted end of range stretches.
- Functional rehabilitation – movement patterns of daily living e.g. hand to mouth, hand to head, reaching etc.
 - Functional activities involving shoulder abduction can also stress the lateral structures and should be avoided for the first 6 weeks (Sayles, 2007).
- Can start gentle grip strengthening but no active elbow or wrist strengthening exercises
- until Phase II (Seacoast Orthopaedics)
- Sling should only be used when patients are out in busy or crowded locations but not around the house and not to bed (Seacoast Orthopaedics)
- Incision mobilization and desensitization
- Modalities for pain, inflammation and oedema control
- Cryotherapy as needed
- Ulnar nerve desensitization (Seacoast Orthopaedics)

PHASE II –FUNCTIONAL ACTIVITY PHASE

(Not to begin before 6 Weeks post-surgery to allow for appropriate soft tissue healing):

Phase II Goals:

- To encourage functional ROM and strength of the elbow for ADLs, while protecting healing soft tissues.
- Minimize pain and inflammation.
- Re-establish dynamic elbow stability (J. Sayles, 2007)

Phase II Precautions:

- No repetitive motions of more than 2 lbs. and no single lifts of more than 5 lbs. with operated upper extremity.
- Those patients with a resurfacing procedure should not perform combined repetitive extension/supination exercise or activity.
- No upper extremity weight bearing, pushing, or pulling with the involved side. (J. Sayles, 2007)

Early Phase II (6-12 Weeks postoperatively):

- **6-8 weeks post-op:**
 - Continue shoulder elbow and wrist ROM
 - Most strengthening gains will be achieved by the patient gradually progressing their activity level. The need for a vigorous strengthening program is not appropriate following total elbow arthroplasty.
 - Night time extension splinting if flexion contracture developing
 - Begin submaximal painfree elbow/forearm/wrist/hand isometrics at mid range of available elbow range of motion (all planes). Can add active extension (anti-gravity only but no resistance).
 - May begin gentle isometric and isotonic wrist flexion/extension and elbow flexion strengthening.
 - Biceps strengthening should be done with elbow supported.
 - No elbow extension strengthening.
 - Sling should be fully discontinued at this point.
 - Continue scar massage (Seacoast Orthopaedics)
- **8-10 weeks post-op:**
 - Active range of motion in all planes
 - Continue night time extension splinting if necessary
 - Dynasplint if flexion contracture less than 30 degrees
 - Progress to submaximal painfree elbow/forearm/wrist/hand isometrics at multiple angles of available elbow range of motion. Avoid isometrics at end ranges of motions.
 - May add anti-gravity active extension but no resistance
 - May add exercises for shoulder to promote generally upper extremity conditioning (Seacoast Orthopaedics)
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- **10-12 Weeks post-op:**
 - Maintain splint at night for 12 weeks
 - Progress to sub maximal pain free shoulder and elbow/wrist/hand isotonic strengthening as motor control improves. (No weights or resistance greater than 2 lbs.)
 - Initially single plane elbow movement, then progress to composite movements as appropriate. Those patients with a resurfacing procedure should not perform combined repetitive extension/supination exercise or activity.

- Begin anti-gravity control of triceps, active assisted in supine and progress to active as control and strength improves with holds throughout range.
- If patient has not achieved functional elbow range of motion of at least 120 degrees flexion then consider the use of a dynamic or static progressive splint. Consult with surgeon.
- Continue use of cryotherapy and oedema management for pain and inflammation as needed (J. Sayles, 2007)

Late Phase II (12 weeks postoperatively on):

- Continue maintenance flexibility program
- Progressive isotonic resistance including elbow extension
- Progress to functional use (Seacoast Orthopaedics)
- Typically patients are on a home program at this point focused on maintaining a pain free functional arc of elbow motion
- Continue previous exercises 2-3 x/ week to maintain ROM, strength, and function upon discharge from therapy
- A pain-free joint with functional range for activities of daily living
- No heavy lifting of objects (no heavier than 10-15 lbs) for life
- No golf, tennis, or throwing activities for life. (J. Sayles, 2007)

Patient goals and activity level also play a role in determining therapy guidelines and expectations after total elbow arthroplasty. Despite stringent guidelines for patient selection, there is still a variance in patient goals and expectations for range of motion, strength, and desired activity level following surgery. The patients with more active lifestyles often have to be reminded of these restrictions. They usually require slightly longer periods of protective splinting to prevent overuse. These patients often tend to have increased expectations for range of motion and tend to remain in therapy longer for passive stretching and static progressive splinting programs because of these increased expectations (M. Szekeres 2006).

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