Management of Flexion Contractures of the Wrist by Differential Distraction

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Abstract

Flexion contractures of the wrist are a dreaded complication of Volkmann’s ischemic contracture, postinfective/posttraumatic destruction of the wrist, or tuberculosis of the wrist joint. Most of the times, the patient is advised an amputation with prosthetic replacement as the treated limb also is like a dead limb. To avoid it, a simple alternative is to use the principle of controlled differential fractional distraction histogenesis. Joshi’s external stabilization system (JESS) distractors allow gradual distraction of contracted soft tissues and align all the joints of the hand so as to bring corrections of all aspects of hand and wrist deformity simultaneously. This study was done with the aim to analyze the role of differential distraction in correcting cases of flexion contractures of the wrist in terms of cosmetic, functional, and anatomical outcome. Three flexion contractures of the wrist and hand underwent differential fractional distraction. Patients were assessed preoperatively for morphology, functionality, and radiology period of correction varied from 5 to 8 weeks. Once correction was obtained, then apparatus for differential distraction (JESS) is locked in that position for the same period and later converted to plaster cast for maintenance and followed up regularly. Excellent-to-good results were obtained in all the cases as assessed with patient-rated wrist evaluation. There were only minor complications in patients. Differential distraction by JESS frame is a simple, versatile, and cheap method suited for correcting flexion contractures of the wrist and hand, which were neglected and resistant.

Keywords: Differential distraction, flexion contractures of wrist, Joshi’s external stabilization system, patient-rated wrist evaluation

INTRODUCTION

Flexion contractures of the wrist are a dreaded complication of Volkmann’s ischemic contracture (VIC), destruction of wrist following infection or trauma, or tuberculosis of the wrist joint. Volkmann’s contracture is the most common cause for wrist contractures, with overall incidence of 0.5% of all orthopedic cases, most lived in rural areas. Shortening of the muscles results in deformity of the hand and fingers, with restricted range of motion, pain, and functional variation. Prolonged wound healing with fibrosis and immobilization can lead to secondary joint contractures. The standard treatment for these contractures is by release followed by skin cover with split skin graft, prolonged immobilization, and splintage. Most of the times, the patient is advised an amputation with prosthetic replacement as the treated limb also is like a dead limb. To avoid it, a simple alternative is to use the principle of controlled differential fractional distraction histogenesis. Joshi’s external stabilization system (JESS) distractors allow gradual distraction of contracted soft tissues and align all the joints of the hand so as to bring corrections of all aspects of hand and wrist deformity simultaneously. Correction of these deformities by distraction without open surgery and grafting has been done effectively in this study.

CASE REPORTS

Three patients with severe flexion contracture of the wrist, one with VIC, one with juvenile rheumatoid arthritis, and other with postinfective wrist joint destruction, were evaluated preoperatively clinically and radiologically. In all the cases, distractors were applied under general anesthesia. The indication for treatment was mainly functional in all the cases.
1. PAIN

| Rate the average amount of pain in your wrist over the past week by circling the number that best describes your pain on a scale from 0-10. A zero (0) means that you did not have any pain and a ten (10) means that you had the worst pain you have ever experienced or that you could not do the activity because of pain. |
|---|
| RATE YOUR PAIN: Sample Scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| At rest | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| When doing a task with a repeated wrist movement | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| When lifting a heavy object | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| When it is at its worst | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| How often do you have pain? | Never | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

2. FUNCTION

A. SPECIFIC ACTIVITIES

| Rate the amount of difficulty you experienced performing each of the items listed below over the past week, by circling the number that describes your difficulty on a scale of 0-10. A zero (0) means that you did not experience any difficulty and a ten (10) means it was so difficult you were unable to do it at all. |
|---|
| Sample scale | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Turn a door knob using my affected hand | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Cut meat using a knife in my affected hand | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Fasten buttons on my shirt | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Use my affected hand to push up from a chair | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Carry a Tote object in my affected hand | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Use bathroom tissue with my affected hand | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

B. USUAL ACTIVITIES

| Rate the amount of difficulty you experienced performing your usual activities in each of the areas listed below over the past week, by circling the number that best describes your difficulty on a scale of 0-10. A zero (0) means that you did not experience any difficulty and a ten (10) means it was so difficult you were unable to do any of your usual activities. |
|---|
| Personal care activities (dressing, washing) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Household work (cleaning, maintenance) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Work (your job or usual everyday work) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Recreational activities | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Figure 1: (a) Table with pain scale of patient-rated wrist evaluation, (b) Table with functional scale of patient-rated wrist evaluation

Figure 2: (a) Preoperative photograph of case 1, (b) Case 1 with Joshi’s external stabilization system frame, (c) after correction of contracture, (d) preoperative radiograph of Case 1, (e) end of correction with Joshi’s external stabilization system radiograph

Figure 3: (a) Preoperative photograph of Case 2, (b) Case 2 with Joshi’s external stabilization system distractor, (c) preoperative radiograph of Case 2, (d) radiograph after correction of Case 2

Dominant hand was involved in all the patients, which made them limiting their most of the routine activities. The results are evaluated using patient-rated wrist evaluation (PRWE) as in Figure 1, comparing the preoperative and postoperative score as assessed by the below-mentioned questionnaire.

Case 1

A 12-year-old female child with stiffness of wrist and clawing of hand of the right side with limitation of her major activities, learning, and writing and also difficulty in feeding by herself had 80° of fixed flexion deformity in the wrist with intrinsic minus deformity in the hand. A diagnosis of seronegative rheumatoid arthritis with positive antinuclear antibodies (ANA) was made based on serological markers for inflammatory arthritis and clinically. After basic blood investigation and radiological evaluation, the patient was planned for deformity correction.
by JESS distraction. Distraction frame was constructed using K-wires and JESS distractors as shown in Figure 2. Controlled differential distraction was started after 3 days of surgery and continued for 6 weeks to achieve neutral position at wrist. Following the correction, the assembly was held in static position for 6 weeks to allow soft tissue maturation in the elongation position. Single-stage removal of the whole assembly was done under mild sedation, and a well-molded plaster cast was applied in maximum correction for 4 weeks. Preoperative PRWE score was 72, and after correction, PRWE score was 36. And with extensive physiotherapy, the patient score improved to 16.

Case 2
A 5-year-old male child with Tsuge’s moderate-type VIC of the right forearm which was infective sequelae in infancy had flexion deformity of wrist fixed at 90° with ulnar deviation. After blood and radiological investigations, JESS distractor frame was built on the forearm under general anesthesia. Fingers were held to the frame with elastic bands to prevent flexion contracture. Differential distraction was initiated after 3 days of surgery and continued for 4 weeks till neutral position was achieved as shown in Figure 3. During the period of distraction, loosening of the forearm pin was found with pin site infection, which was controlled with oral antibiotics, and premature removal of assembly had to be done without stepping into static phase. Subsequently, serial casting was used to achieve further extension for 4 weeks. Further, physiotherapy helped the child to achieve PRWE score of 22, which was 86 preoperatively.

Case 3
A 24-year-old female with stiffness of the right wrist, which was a complication of untreated septic arthritis of the wrist, was found to have fixed flexion deformity of wrist at 90°, and on investigating her blood reports and radiographs, it revealed destroyed distal radius and ulna with bony spike projecting dorsally and the wrist subluxed anteriorly and osteoporosis with sclerosis of bony ends depicting low-grade nature of disease. After controlling infection, JESS distractor frame was constructed under anesthesia and distraction was done for 5 weeks to achieve neutral position as shown in Figure 4 without any complication, and frame was removed and well-molded plaster was applied for 4 weeks and followed by physiotherapy that helped this patient to achieve functioning wrist by closed method. The PRWE score preoperatively was 85, and after distraction and physiotherapy, PRWE score decreased to 18.

Discussion
The standard treatment for these contractures has been surgical release and skin cover with full-thickness grafts. All methods involve open surgery under anesthesia, usually general anesthesia, with harvesting of full-thickness grafts, which in a young patient may occasionally be a problem due to lack of donor sites. There are inherent complications of surgery, viz., damage to the neurovascular bundles during surgery; finger tip ischemia when a chronically contracted finger is acutely straightened outputting stretch on the neurovascular bundles; a contracted but uninjured tendon preventing the full straightening of the finger; and wound infections. The basic principle of external fixation (JESS) in this study was the same as advocated by Ilizarov. Physiological tension and stress applied to the tissue stimulate histogenesis of tissues, while controlled differential distraction gradually corrects the deformities and realigns the bones. Although many authors have mentioned the use of distraction for the treatment of clubfoot, there are no well-documented series reported on the use of distraction for contractures of fingers and hand. By distraction straightening, the principles of a gradual dynamic lengthening of the skin and soft tissues are applied. All tissues get stretched out, thus maintaining a sensate pliable skin cover.

Conclusion
Although this series is a small one, it is a representative one in the use of the minimally invasive technique of distraction in treating flexion contractures of the wrist, which is a relatively common condition. The functional and esthetic results of this simple procedure are excellent. The distractor can be reutilized; the procedure being simple, intelligent patients and parents can be easily trained to do the distraction at home and come only for outpatient follow-up. The complications of open surgery such as injury to the neurovascular bundles, tendons, wound infections, and graft loss are minimized. The functional and cosmetic results of this procedure are highly satisfactory. Motivated and compliant patients were a pivotal factor on which the success of the study depended. Although the technique has many advantages, one should not forget that injudicious and unsupervised distraction may lead to catastrophic results in the small developing hand. Long-term studies are required to accurately assess the functional outcome. The aim of this paper is to offer distraction as an easy, economical, and minimally invasive technique for treating contractures of the wrist and hand.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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