CASE REPORT

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Effectiveness of Osteopathic Manipulation Treatment in the Rehabilitation of Post-External Immobilization for a Supracondylar Fracture of the Distal Humerus: A Case Report

Abstract

Pediatric bone fractures are a common occurrence, particularly among youth sports participants. Supracondylar humeral fractures are the most common pediatric elbow fracture, accounting for approximately 60% of all pediatric elbow fractures for children less than 10 years of age. For nondisplaced supracondylar humeral fractures, the standard of care is to immobilize the affected arm with an above the elbow-long cast for 3 weeks. Following cast removal, the recommendations for rehabilitation are conflicting, between doing some physical therapy as part of recovery or no therapy and letting the arm heal on its own for upwards of 12 weeks. The purpose of this case report was to observe if the addition of osteopathic manipulation treatment (OMT) could improve the somatic dysfunctions associated with post-immobilization elbow stiffness and reduce the amount of recovery time. Various OMT techniques were utilized over a span of 8 sessions across 4 weeks. The use of OMT provided relief of stiffness and return to full range of motion of the affected upper extremity joints. The incorporation of OMT as a part of a recovery regimen could be considered for future utilization, research, and evaluation.

Background

Pediatric bone fractures are a common occurrence, particularly among youth sports participants. According to a study by Swenson et al, approximately 10.1% of all injuries in teenagers are fractures. The most common locations of the fractures are the hand/finger (28.3%), wrist (10.4%), and lower leg (9.3%).[1] Moreover, among children aged 10-19, the incidence of sports-related fractures is 5.63 per 1000 individuals in one year, with 87% of all fractures and 84% of those in the upper extremity occurring in males.[2] Sports related fractures are also common in children age 5-12, accounting for 13.4% of all sports injuries in this age group.[3] However, among children, these fractures appear to occur most frequently in the upper extremity while lower extremity fractures are more common in the teenagers.[3]

Upper-extremity injuries account for approximately 65-75% of all pediatric injuries, as children tend to protect themselves with outstretched arms.[4] In particular, supracondylar humeral fractures occur in approximately 60% of all pediatric elbow fractures.[4,5,6] According to Cheng and Shen (1993), their retrospective study indicated that supracondylar humeral fractures accounted for 17% of all the fractures of the 3,350 participants, the second most common

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overall following distal radius fractures (19.9%).[5] In a follow-up study, Cheng et al (1999) examined a larger population of fractures across a 10-year period, and again showed similar rates of supracondylar humeral fractures (17.9% out of 6,493 recorded fractures), with a similar age stratification.[6]

According to treatment guidelines, the use of an above-elbow posterior fiberglass cast and sling is standard of care for a stable grade I supracondylar fracture of the humerus, resulting in good functional outcomes.[7,8] The usual course is to have 3 weeks of immobilization by casting to allow for healing of the bone, and surgery is not required, so as long as the bone does not become displaced.[9]

The physical therapy approach to pediatric supracondylar humeral fractures is unclear and limited. Some studies have shown improvement with physiotherapy following surgical reduction, but no significant statistical benefit has been reported.[10,11] According to physical therapy clinical guidelines for elbow stiffness, recommendations include: the use of heat to achieve elongation of the connective tissue, myofascial soft tissue mobilization and joint mobilization, range of motion techniques utilizing passive range of motion and contract-relax techniques, muscle energy techniques, splinting, and strengthening exercises.[12] Many of these terms are similar to terms used in osteopathic manipulation treatment (OMT). Yet, to our knowledge, there are no publications that directly address the use of OMT in a supracondylar fracture rehabilitation setting. This case report demonstrates the use of OMT in the recovery of range of motion following external immobilization of a supracondylar humeral fracture.

Case Report

The university IRB was contacted, and authors were informed that the case report publication did not require IRB approval since it did not involve human subject research. Consent was obtained by the patient's parents and assent from the patient to report the case.

The patient was a healthy 10-year-old white male, right hand dominate, with a history of normal delivery at birth. The patient had typical growth and development for his age. The patient was seen for rehabilitation of his left arm following a grade I supracondylar fracture of the distal humerus. The patient had no prior fractures and no other contributory medical concerns. The patient had sustained the injury following a fall on the posterior side of the left arm while playing basketball. He was seen at a local urgent care and radiograph findings indicated that the patient had a supracondylar fracture with no growth plate disruption. An orthopedic surgery consult was recommended, which occurred 3 days later. Per the orthopedic surgery consult, the patient was placed in a standard plaster fiberglass cast and had the left elbow immobilized in a 90° angle for 3 weeks. The cast covered the length of the arm from approximately the middle left humerus to the left hand. The left-hand digits were able to freely move. The cast was removed at the follow-up appointment and repeat imaging indicated that the fracture had healed. The patient was prescribed at-home physical rehabilitation including range of motion, stretching, and mild strengthening exercises to improve muscle tone.

Following cast removal, the physical exam was performed by the orthopedic nurse practitioner and observed by the OMT-providing osteopathic medical student. The patient appeared of normal height and development for stated age. The left elbow was still bent at the 90° angle and the left arm and forearm were medially rotated at the shoulder. The left arm showed signs of non-erythematous inflammation and ecchymosis at various stages of healing, ranging in color from yellow and pale to dark and purple. There was a noticeable linear ecchymotic line on the anterior skin surface of the left arm located superior to the left elbow and superficially to the fracture line as indicated on the radiographic imaging. The left forearm showed signs of mild atrophy but otherwise normal. The left hand and digits were unremarkable.

During active and passive range of motion testing, there were noticeable restrictions of the various joints of the left arm. The left shoulder was freely movable in flexion and extension, but restricted in abduction, horizontal adduction, and internal and external rotation. The left elbow was mostly fixed at the 90° angle and was restricted in both flexion and extension. Passive range of motion testing of the elbow elicited self-reported tenderness by the patient due to feelings of stiffness. The pain was resolved once passive range of motion testing was discontinued. The left elbow also had more medial deviation when arms held in carrying angle position. The left forearm was restricted in both pronation and supination, with greater resistance in supination. The left wrist showed restriction in both flexion and extension, with greater resistance in extension. Sensation and strength testing were normal throughout the arm. For comparison, the right arm was

Table 1. *Body locations and OMT techniques* utilized*

Body Area	Somatic Dysfunction	Techniques Applied **
Cervical, Upper Trapezius	Paravertebral hypertonicity, Upper trapezius hypertonicity, C4 Neutral Rotated Right, Side bent Left	ST: supine traction, Single Forearm Fulcrum forward bending/Side Bending/Rotation, Bilateral Forearm Fulcrum Forward Bending Method, Suboccipital Release Supine Intermittent/Inhibitory Methods Forefingers Cradling BLT: Indirect into ease of noted dysfunction CS of Lateral Posterior Cervical Region CS of Levator Scapulae
Glenohumeral Joint	Left GH adhesive capsulitis, tendonitis	ART: Glenoid Labrum (Lip) Abduction, Adduction, and Circumduction; ART: Shoulder Girdle: Spencer Technique
Scapula	Scapula Fixation	MFR: Scapulothoracic Articulation Direct
Arm	Restriction of Biceps Brachii and Triceps Brachii	ME: Elbow Flexion, Post-Isometric Relaxation Technique ME: Elbow Extension Post-Isometric Relaxation Technique ME: Elbow Flexion, Reciprocal Inhibition Technique Lym: Lymphatic Drainage
Elbow	Flexion SD Extension SD Elbow Ulnar Deviation Dysfunction	CS: Radial Head-Lateral CS: Medial Epicondyle ART/Still: Elbow indirect direct
Forearm	Fascial restriction of Interosseous Membrane Pronation SD Supination SD	MFR: Interosseous Membrane Direct or Indirect CS: Interosseus Membrane ME: Radioulnar Pronation Dysfunction, Post-Isometric Relaxation ME: Radioulnar Supination Dysfunction, Post-Isometric Relaxation
Wrist	Wrist Flexion SD Wrist Extension SD Wrist Ulnar Deviation SD Wrist Radial Deviation SD	ME: Radiocarpal Abduction and Adduction Dysfunctions Post-Isometric Relaxation ME: Wrist Flexion and Extension Dysfunctions with Post-Isometric Relaxation

*****OMT Techniques used were taken from: Foundations of Osteopathic Medicine, 3rd Edition by Anthony G. Chila and the American Osteopathic Association[13]; Atlas of Osteopathic Techniques 3rd edition by Alexander S. Nicholas and Evan A. Nicholas.[14]

******SD (Somatic Dysfunction) ST (Soft Tissue), MFR (Myofascial Release), CS (Counterstrain), ME (Muscle Energy), BLT (Balanced Ligamentous Tension, ART (Articulatory Technique), Still (Still Technique)

also tested in active and passive range of motion, with no abnormalities noted.

On the osteopathic structural exam, in addition to the above physical exam findings, there was noted muscle hypertonicity in the left cervical trapezius area, the left levator scapulae muscle, the rhomboids and paraspinal muscles attached to the left scapula, and restriction in the left scapula. There were both acute and chronic findings noted on the TART exam (tenderness, asymmetry, restricted motion, and tissue texture changes). The acute TART findings showed the arm was warm to the touch

and the red reflex was positive along the posterior, anterior, lateral, and medial surfaces of the left arm and along the left superior border of the trapezius muscle. There was tenderness to palpation of the left arm and motion restriction as indicated above. For the chronic TART findings, there was chronic ropiness and fullness noted along the rhomboids and paraspinal muscles, with a cooler temperature to the touch, and no asymmetry noted. The remainder of the physical examination was unremarkable.

Interventions

The patient was instructed to continue the prescribed stretching and strengthening exercises as per the orthopedic nurse practitioner. The patient was instructed to return to normal range of motion activities and to avoid intense physical activity to avoid re-injury of the fracture site. The patient also was informed to take children's ibuprofen twice a day for 10 days to reduce the inflammation of the arm and to assist with any tenderness.

OMT Interventions

The patient was treated by the osteopathic medical student under the supervision of the osteopathic faculty. Supervision was conducted via both direct in-session remote video conferencing and post-session reviews of recorded session videos; supervision was conducted remotely due to the public health restrictions related to the COVID-19 pandemic. The patient received several different OMT techniques with sessions occurring twice per week for 4 weeks, for a total of 8 OMT sessions. Baseline and intermittent range of motion measurements were attained with goniometers (Arthroflex), using various sizes for different size joints. Prior to sessions, a microwave heat pad was applied to the left elbow area to loosen the musculature prior to initiating OMT techniques. During each session, range of motion testing and somatic dysfunction were assessed prior to treatments and immediately after treatments to reassess for changes in somatic dysfunctions. The techniques chosen for each session were dependent on the prevalent somatic dysfunctions and are listed in Table 1.

Results

Following the application of OMT techniques, the patient subjectively reported immediate improvement in cervical and trapezius hypertonicity, with noticeable palpatory decrease of hypertonicity and improved range of motion. Pronation and supination of the left forearm improved to normal range within 2 treatment sessions. The left wrist somatic dysfunctions resolved after 1 session, with improvement of flexion and extension equal to the unaffected opposed right wrist. The restrictions of the left shoulder improved after one session using the articulatory and myofascial release techniques, with the patient regaining the full range of motion of the shoulder joint.

The restrictions in left elbow extension resolved after 2 treatment sessions, returning to a complete 0° in extension. The upper arm and elbow dysfunctions recovery were more prolonged, as this was the primary site of injury and fixation during immobilization. Full range of motion was obtained by the 5th session, with minor fascial restrictions noted on the upper arm and elbow flexion. Range of motion of the left elbow joint had gradual improvements with each ensuing session. Biceps and triceps hypertonicity had improvements upon palpation and myofascial movements. Lymphatic drainage after each session helped to reduce swelling of the elbow and upper arm areas, with noticeable improvement within the first four sessions. The patient's subjective report of pain and muscle stiffness, in addition to functional status, had gradual improvement throughout the sessions, with noticeable decrease of tenderness to palpation. Table 2 gives a summary of the goniometer measurements in comparison of the left arm joints at baseline, intermittent sessions, and at end of treatment to the unaffected right arm baseline measurements.

Discussion

The results of this case report showed some noticeable improvement in the recovery to full range of motion of upper extremity joints, specifically elbow flexion and extension following immobilization of a supracondylar humeral fracture. Shoulder range of motion measurements were discontinued after the fourth session due to return of normal range of motion measurements and treatments being more targeted to the site of the injury. The patient was able to return to baseline range of motion over 8 sessions across 4 weeks, with only minor reductions in wrist extension and forearm supination at the end of session measurements unrelated to the casting or injury. Full range of motion testing, without measurements, and confirmation of intact sensation were confirmed by the orthopedic nurse practitioner at the patient's follow-up appointment 7 weeks after the removal of the cast. Final measurements were completed by study author for consistency. In contrast, a study done by Jha, Shakya, and

Table 2: Goniometer joint range of motion measurements (in degrees)

	BL Left*	Post 1st*	Post 4th*	End*	Normal Range[15]	BL Right
Wrist Flexion	30	68	68	76	0 to 60	75
Wrist Extension	30	70	70	63	0 to 60	70
Forearm Pronation	75	80	80	80	0 to 80	70
Forearm Supination	32	70	75	65	0 to 80	65
Elbow Flexion	80	105	120	132	0 to 140	135
Elbow Extension	10	5	5	0	-10 to 0	2
Shoulder Flexion	175	180	-----	180	0 to 180	180
Shoulder Extension	65	65	-----	65	0 to 50	70
Shoulder Abduction	85	180	-----	180	0 to 180	180
Shoulder Horizontal	85	180	-----	180	0 to 180	180
Adduction	120	137	-----	145	0 to 130	140
Shoulder IR with 90° elbow flexion	75	30	-----	90	0 to 90	90
Shoulder ER with 90° elbow flexion	90	90	-----	90	0 to 90	90
Shoulder ER with 90° elbow flexion	90	90	-----	90	0 to 90	90

***** BL Baseline, Post First Session, Post Fourth Session, End of Treatments

Baral showed no significant differences in children receiving physiotherapy from physical therapists in a hospital setting versus no physiotherapy following closed reduction and above elbow slab (cast) for grade I supracondylar fractures or closed reduction with k-wire pinning for grade II and III supracondylar fractures.[16] In their study, the authors concluded that the children who had a supracondylar humeral fracture were able to regain full range of motion and function at approximately 12 weeks after injury, regardless of participation in physiotherapy and severity of injury.[16] While the Jha study shows that full recovery is most likely in children over time, this case report demonstrated that the use of OMT was able to shorten recovery time.

This case report has some limitations. In disclosure, the patient is the son of the osteopathic medical student and was seen in the home under remote supervision by the attending osteopathic medicine faculty due to the COVID-19 pandemic restrictions. We acknowledge that the unique relationship allowed for more consistent and timely treatments. Furthermore, the OMT techniques chosen were based on the indications specific to the somatic dysfunctions. The techniques chosen do not encompass the full scope of possible OMT that could have been utilized, varying on practitioner preference. The treatments were initially broader across the upper extremity in earlier sessions, then became more focused on the site of injury.

Furthermore, we acknowledge that in the greater public setting, most patients may not have adequate access to osteopathic physicians that practice OMT and may not be able to adhere to the frequency of sessions as occurred in this case report. As recently reported in the *Journal of Osteopathic Medicine*, the use of OMT among osteopathic physicians continues to decline. Many factors contribute to decrease use including lack of time, low reimbursement rates, and lack of institutional support.[17] In addition, patients are more likely to be seen by physical therapists for injury rehabilitation, as they may be more readily available depending on the area of the country;[12,18] thus patients may not have access to the expertise that an osteopathic physician could perform OMT as part of a rehabilitation program.

Conclusion

Despite the barriers and limitations, this case report demonstrated that OMT has its place for the treatment of injuries, as evidenced by the rate of improvement that was reported. Patients who have a fracture, especially in the elderly on Medicare, may have an increase in the utilization of adjunct recovery services resulting in higher costs.[19] As evident in this case report, the use of OMT reduced recovery time to only 4 weeks. While the case report focused on the rehabilitation of an otherwise healthy pediatric patient with a potential faster recovery time, the use of OMT in the promotion of healing and recovery, as well as the reduction of time spent in services, could still be applicable to patients of all ages. Furthermore, the evidence of the case report could encourage more osteopathic physicians to utilize their OMT skills in aiding the rehabilitation of their patients recovering from similar injuries.

Research related to the use of OMT in aiding the recovery of fractures, specifically supracondylar humeral fractures, is limited. We recommend that further research into the use of OMT following fractures as part of a rehabilitation program is warranted and could expand the use of OMT as more evidence of effectiveness of the treatment approach becomes available.

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