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A Case Report of a Juvenile Volkmann's Ischemic Contracture

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Abstract

Aim: This study was conducted to determine the outcome of physiotherapy intervention in a juvenile case of Volkmann's ischemic contracture.

Methodology: The patient was an 8-year-old female pupil presenting with flexion deformity of the right elbow, wrist and fingers accompanied with pain and difficulty in performing activities of daily living of 5 months onset. She received physiotherapy including home program for 43 sessions with a periodic review of the intervention after the 22nd, 33rd and 43rd treatment sessions.

Results: The outcome variables included pain intensity, range of motion, muscle girth, and functional ability. Ranges of motion changed as follows: elbow flexion 85° to 120°; elbow extension 85° to 120°; wrist flexion 18° to 19°; wrist extension 36° to 46°; pronation 30° to 180°; supination 50° to 180°. The patient demonstrated palpable improvements in all these parameters. Pain also dropped from 7 to 4 and sometimes lesser. There was no significant muscular atrophy in the forearm despite the compromise of the muscle length-tension relationship but in the thenar and hypothenar eminences. A very tiny, subtle and rather tricky to detect anesthetic spot was observed on the palm.

Conclusion: We therefore concluded that physiotherapy had a positive outcome for children with Volkmann's ischemic contracture and had the potential to reduce the cost of future surgeries for patients.

Keywords: Volkmann ' s ischemic contracture; Physiotherapy; Outcomes

Introduction

Volkmann's ischemic contracture is a deformity of the hand, wrist and fingers which results from acute ischemia and necrosis of the muscle fibers of the flexor group of muscles of the forearm, especially the flexor digitorum profundus and flexor pollicis longus [1,2]. The muscles become fibrotic and shortened. Named after Richard von Volkmann who first described it, the condition is caused by obstruction on the brachial artery near the elbow, possibly from improper application of a tourniquet, improper use of a plaster cast, or compartment syndrome [1,3]. It is also caused by fractures of the forearm bones if they cause bleeding from the major blood vessels of the forearm resulting in a claw-like deformity of the hand and fingers [1,2]. Any fracture in the elbow region or upper arm may lead to Volkmann's ischemic contracture, but it is especially associated with supracondylar fracture of the humerus. Passive extension of fingers is restricted and painful, this being particularly the case if the wrist is concurrently extended [4].

Case Presentation

We present a case of an 8-year-old female pupil with the complaints of pain and stiffness in the elbow and wrist of about 2 months duration, which also affected her activities of daily living. The informants were patient's parents who also gave consent to this clinical study. There was a history of injury, when the patient had a fall on her right elbow of about 5 month's onset while in school. She was taken to the local unorthodox traditional bone setters who massaged the elbow and kept the affected arm in bandage for 7 days. Subsequently, it was noticed that the hand and fingers were not straightening out, so she was taken back to the traditional bone setters who reapplied the bandage in an attempt to straighten out the hand. After about 2 hours of the re-application of bandage, her mother observed that the hand was swollen, thus necessitating its removal.

In a desperate effort to improve care to the child, she was taken to a hospital where a radiologic investigation was conducted. A diagnosis of displaced right olecranon fracture was made and then the hand was immobilized in a sling and hung for about a week. During this period, the patient complained of numbness, so the hand was then being hung intermittently. Next, she received physiotherapy in the hospital for 3 weeks, when it was observed that the wrist and fingers were developing flexion deformity. This led to her referral to our tertiary hospital for 'expert management.'

Assessment

The patient reported a pain experience of 7 on the visual analogue scale. There was flexion deformity at the right elbow and wrist in addition to flexion deformity of the 2nd, 3rd, 4th and 5th proximal interphalangeal joints of the right fingers.

There was pain at the wrist and elbow joints and pain on passive movement of the middle metacarpophalangeal joint. The skin sensation was intact though a very tiny portion on the forearm and volar aspects presented with a subtle territory of anesthesia which we

termed 'fantasy sensory localization,' in that the patient could actually feel a stimulus had been applied but pointed to a different point of application under standard testing conditions. It was believed that the distance between this 'fantasy point' and the actual point of stimulus application determines to a considerable extent the severity of the underlying lesion, prognosis and clinical decision making. Muscle tone was preserved bilaterally; muscle bulk was reduced by about 0.5 cm on the right forearm and with a gross muscle power of 4 in the right upper limb. Volkmann ' sign was positive, consisting of exaggerated deformities of the fingers with attempted wrist extension which becomes less apparent with attempted wrist flexion. The ranges of motion at the joints were measured by one of the researchers OL using a goniometer.

Treatment Plan

The line of management for the first 7 treatment sessions consisted of ultrasound (continuous mode, low intensity, 15 mins) to flexor compartment of the elbow and wrist to relieve pain and promote tissue extensibility; passive stretching of the wrist flexors, elbow and fingers to stretch contracted structures; finger kneading massage to the flexor compartment of the elbow and wrist to promote tissue extensibility, resisted exercises to the wrist to strengthen the antagonists (wrist extensors); and functional exercises (writing, paper picking, reeducation board with frictionless surface) to increase the range of motion and promote optimal function. Electrical stimulation was given to all the muscles of the forearm with emphasis on the wrist and finger extensors to counteract the flexion deformities of the wrist and fingers as well as activate the weak musculature and improve tonicity. Infrared radiation helped to relieve pain and improve blood circulation to the weak muscles and enhance the viscoelastic properties of the muscles. Massage helped to promote soft and supple musculature and prevented muscular adhesions. These modalities were also used in a previous study [1].

Treatment Plan Review

After 22 treatment sessions, further radiologic investigation of the elbow was carried out, which revealed healed, well-aligned incomplete transverse fracture of the right olecranon. That of the wrist and hand revealed flexion at the wrist, metacarpophalangeal and proximal interphalangeal joints. Consequently, a modified treatment regime for another 21 sessions was instituted. Infrared and cryotherapy (for further pain relief) were added; functional electrical muscle stimulation was applied to the wrist extensors (for muscle strengthening and to build muscle bulk); and reciprocal pulley and reeducation board (to increase the range of motion at the elbow). A multidisciplinary approach was incorporated, and the patient was receiving an analgesic injection (pentasocine) prior to every physiotherapy intervention (this was because the pain during physiotherapy intervention, especially contracture stretching, was usually unbearable). Afterwards, removable casting was done to the right upper limb to maintain the elbow and wrist in extension. This helped to provide sustained passive stretching of the contracted musculature.

Results

The results in this study are presented in the Table 1 and Table 2, and also in Figures 1-3.

Table 1 and Table 2 show the ranges of motion at the various joints of the affected right upper limb and the anthropometric characteristics of both upper limbs, respectively.

Session/Test	Assessment Position	Landmarks (Moveable Arm/Stable Arm/ Fulcrum)	Goniometry Value/ (Net)
Baseline			
Elbow Flexion	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	30°-115° (85°)
Elbow Extension	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	115°-30° (85°)
Wrist Flexion	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	36°-54° (18°)
Wrist Extension	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	54°-90° (36°)
Pronation	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	180°-150° (30°)
Supination	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	180°-130° (50°)
After 22 treatment sessions			
Elbow Flexion	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	60°-110° (50°)
Elbow Extension	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	110°-85° (25°)
Wrist Flexion	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	90°-15° (75°)

Wrist Extension	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	40°-60° (20°)
Pronation	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	90°-155° (65°)
Supination	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	75°-155° (80°)
After 33 treatment sessions			
Elbow Flexion	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	16°-117° (101°)
Elbow Extension	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	117°-16° (101°)
Wrist Flexion	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	85°-0° (85°)
Wrist Extension		Little finger/ulna bone/pisiform bone	0°-40° (40°)
Pronation	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	0°-90° (90°)
Supination	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	0°-90° (90°)
After 43 treatment sessions			
Elbow Flexion	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	0°-120° (120°)
Elbow Extension	Supine	Radius Bone/Humerus/Lateral epicondyle of Humerus	120°-0° (120°)
Wrist Flexion	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	0°-55° (55°)
Wrist Extension	Sitting on a chair with wrist hanging at the edge of a table	Little finger/ulna bone/pisiform bone	0°-46°(46°)
Pronation	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	180°-0° (180°)
Supination	Sitting on a chair, forearm resting on a table with fingers flexed on a pen as in a fist	Parallel to the pen/perpendicular to the floor/3rd MCP joint	0°-180° (180°)

Table 1: Joint range of motion.

Muscle Girth	**Right (cm)**	**Left (cm)**
Baseline		
Upper arm (10 cm above cubital fossa)	18.5	20
Forearm (10 cm below cubital fossa)	Not taken	Not taken
Limb length (from the acromion to the tip of the middle finger)	52	57
At the end of 22 sessions		
Upper arm (10 cm above cubital fossa)	18.5	18.5
Forearm (10 cm below cubital fossa)	17.5	19
At the end of 33 sessions		
Upper arm (10 cm above cubital fossa)	18	18
Forearm (10 cm below cubital fossa)	15	16
At e end of 43 sessions		
Upper arm (10 cm above cubital fossa)	20	19.4
Forearm (10 cm below cubital fossa)	16.3	14.5
Hand	18.3	14.5
LIMB LENGTH (from acromion to the tip of the middle finger).	62	66

Table 2: Anthropometric measurement.

Figure 1 shows the graphical presentation of the changes in ranges of motion at the various joints along with treatment sessions.

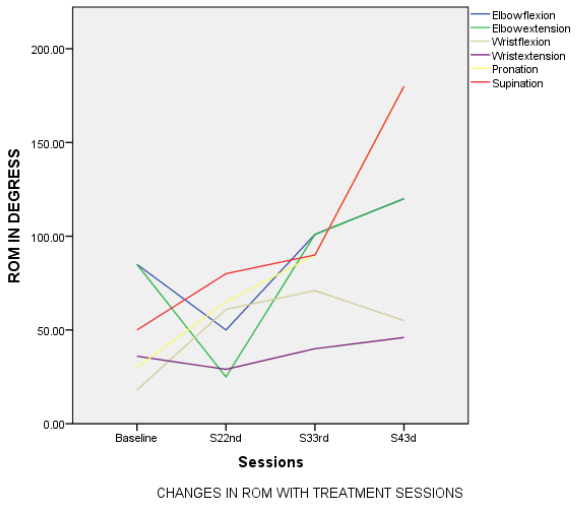

Figure 1: Graphical presentation of the changes in ranges of motion at the various joints along with treatment sessions.

Although improvements occurred in all the ranges of joint motion, they were remarkably poor in the wrist (from 18° to 55°) and therefore the neighbouring joints of the right thumb and fingers.

Figure 2 and Figure 3 are showing the deformities.

Figure 2: Range of motion and appearance of hand deformity.

Figure 3: Marked range of movement at right elbow with residual deformity of the fingers.

Phenomenal changes were observed in the child's ability to use the right hand for functional activities which enabled her to cope in school despite the fixed flexion deformity of the fingers. After removal of serial castings, there was still persistent contracture and deformity, despite the fact that the pain experienced dropped to 4 on the visual analogue scale.

Discussion

The various treatments/modalities administered to the patient were well tolerated except passive stretching which the child so dreaded because it often elicited pain. Some of these were also used in a previous study by Ganesh and Dalal who found that physiotherapy was very effective in the case of an adult with Volkmann ischemic contracture [1]. However, there was no indication their treatment included reeducation board, which we believed helped us to achieve a spectacular improvement in the elbow range of motion in this study from 30 degrees to 130 degrees. This important therapeutic adjunct enabled the patient to have control over her elbow movements while working within tolerable pain threshold and simultaneously receiving feedback on her exercise performance. It is a kind of auto-assisted exercise like the use of overhead reciprocal pulley. Moreover the duration of our study surpassed that of Ganesh and Dallal [1].

That the affected forearm in this study showed atrophy was not at all unexpected because studies have demonstrated that when a muscle cannot work over the full range of a joint it atrophies [5,6]. This is a kind of disuse atrophy. It is interesting, however, that the upper arm of the affected extremity did increase bulk more than the unaffected contralateral counterpart. This is an expression of our theory because we had hypothesized that any injury or disease in any part of a limb has a 'telescoping effect' on all the other segments whether neighboring or distant. Armed with this theory, we had tried to extend exercises to the unaffected proximal aspects, precisely the upper arm and the shoulder girdle of the patient. One of the exercises given was asking the child to bounce a weighty ball using the affected hand. This obviously supplied resisted exercise which helped to strengthen and hypertrophy the muscles [7]. On the other hand, the unaffected contralateral upper extremity was largely excluded from this training

regime. The improvement in motor strength from this activity must have contributed to the overall functional performance of the hand and the entire upper limb. Physiotherapists and other health professionals involved in motor rehabilitation of a limb should therefore endeavor to not limit treatment to the primary site of lesion.

Goniometric assessment of the fingers was not done because of the difficulty in obtaining reliable measurement. However it was observed at rest that the fingers are clawed as shown in Figure 3. While the fingers can be flexed fully, they cannot be extended appreciably, except the wrist was also flexed, attempts to extend the fingers with wrist extension often provoked pain, especially of the middle finger. The metacarpophalangeal joint can also not be extended. Small callosities appearing dark later began appearing on the dorsum of the proximal interphalangeal joints, perhaps due to pressure from some continuous friction on the hand.

Conclusion

We have presented a rare case of Volkmann's ischemic contracture of the right forearm and hand in a child. This case study has highlighted the serious rehabilitation challenges posed by this condition, especially in dealing with contractures or soft tissue compliance, limitation of range of motion and functional limitations with participation restrictions. It is suggested that early referral to hospital as a deterrent to intervention by quacks or unorthodox healthcare providers and cautious handling of the affected elbow should be a top consideration for judicious care in Volkmann's ischemic contracture. Clinicians dealing with acute injuries involving the elbow in a child should avoid early manipulation or mobilization to avoid exacerbating symptoms and the potential development of myositis ossificans engendered by the highly estrogenic activity around the elbow of a child. This study has also shown the possibility of nervous damage or compromise in Volkmann's ischemic contracture which should be considered when planning treatment for patients. From time to time discussions were held with the orthopedic/plastic surgeons on the possibility of doing tendon elongation for the contacted wrist and finger flexors but none seemed enthusiastic about its prospect and cost effectiveness. It is rewarding, however, that though the dominant hand was affected in this study, the child has continued to use the affected hand for personal activities to the delight of herself and her parents. As the child ages, there is likelihood of increased flexion deformity in the affected fingers, sustained limb length discrepancy, muscle and bony atrophy. We believe a judicious intervention of expert surgeons can salvage this problem and secure a happy future for the patient.

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References

1. Ganesh BR, Dalal P (2016) Effect of physiotherapy rehabilitation on Volkmann ischemic contracture-A case study. IJAR 2: 896-897.
2. Kaji Y, Nakamura O, Yamaguchi K, Tobiume S, Yamamoto T (2017) Localized type Volkmann's contracture treated with tendon transfer and tension-reduced early mobilization: A case report. Medicine 96.
3. Willy C, Schneider P, Engelhardt M, Hargens AR, Mubarak SJ (2008) Richard von Volkmann. Clin Orthop Relat Res 466: 500-506.
4. France RC (2003) Introduction to sports medicine & athletic training. Cengage Learning pp. 426.
5. Griffart A, Gauthier E, Vaiss L, Williams T, Mallard F, et al. (2018) Functional and socioprofessional outcome of surgery for Volkmann's contracture. Orthop Traumatol Surg Res 105:423-427.
6. Kistler JM, Ilyas AM, Thoder JJ (2018) Forearm compartment syndrome: Evaluation and management. Hand clinics 34: 53-60.
7. Figueiredo VC, de Salles BF, Trajano GS (2018) Volume for muscle hypertrophy and health outcomes: The most effective variable in resistance training. Sports Med 48: 499-505.