

Clinical note

Multidisciplinary conservative management in classical Volkmann's contracture: a case report

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Abstract

This clinical note describes the case of a nine-year-old girl with classical Volkmann's contracture of the left forearm.

The report demonstrates the results and follow-up of conservative orthotic management used as a mode of treatment by a multidisciplinary team. When using an orthosis it is essential to check regularly to attain the desired result.

Introduction

In an anatomic compartment, muscles are enclosed in ossofascial, relatively noncompliant boundaries. The forearm consists of three compartments; the volar and dorsal compartments and a mobile wad on the lateral side of the radius (Naidu and Heppenstall, 1994).

When pressure rises in a closed fascial space, the circulation is compromised and capillary blood perfusion of intercompartmental tissues, such as muscles and nerves, can be reduced. This condition is defined as a compartment syndrome and can exist without any major arterial injury (Mubarak and Carrol, 1979; Hargens and Mubarak, 1981). If this remains untreated, Volkmann's contracture can occur, as the end result of the ischaemic injury.

Patients suffering this severe complication typically present with a flexed elbow, pronated forearm, flexed wrist, adducted thumb, extended metacarpal phalangeal joints and flexed fingers (Mubarak and Carrol, 1979; Zuker, 1989).

The management of such established

contractures is very complex.

The patient described in this case was treated with a combined stretching and orthotic programme.

Case report

Previous history

A nine-year-old right-hand dominant girl, fell down upon a horizontal bar injuring her left arm. She sustained a greenstick fracture of the radius and a fissure at the distal humerus with a haemarthrosis. She was treated by cast immobilization for three weeks. In the first week she suffered from serious discomfort in the left forearm. Investigation by a neurologist, seven weeks after the accident, revealed a severe functional relapse: loss of ventral and dorsal sensation in the hand, extended metacarpal phalangeal joints, flexed interphalangeal joints and loss of supination of the hand. Electromyography did not reveal a response in either the ulnar or the median nerve. There was complete denervation of the abductor digiti quinti muscle and fibrillations in the abductor pollicis brevis muscle. On the basis of these findings a Volkmann's contracture was diagnosed and the patient was referred to a rehabilitation specialist.

Examination

Ten weeks after the fall, physical examination revealed contracture of the forearm; pronation limited to between 50-80 degrees, absence of supination and flexion contracture of the wrist and fingers, in particular the fourth and fifth. Active motion of the fingers was not possible, except for the thumb, where Froment's sign was positive. Passive dorsal flexion of the metacarpal phalangeal joints was however possible with normal force

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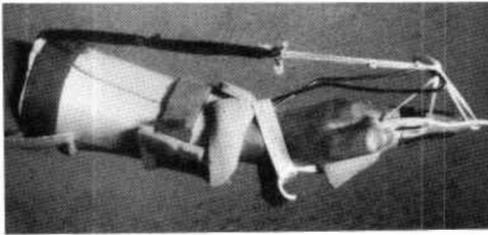


Fig. 1. Dynamic wrist-hand and finger extension orthoses.

and sensation appeared normal.

At the time of examination the patient had received 4 weeks of physiotherapy (2-3 sessions per week) and X-ray examination revealed a consolidated greenstick fracture of the radius and an unimpaired humerus. Electromyography results remained as before.

Treatment

Two months after referral, the patient was admitted to hospital for clinical rehabilitation. Treatment consisted of a combined regime of stretching exercises and wrist-hand-finger orthosis application.

The physical therapy which she received twice a day, consisted of stretching the finger flexors, exercising and coordination of both the extrinsic muscles and stimulating supination of the forearm.

Occupational therapy was undertaken for 2 hours per day, consisting of passive and active stretching of the finger flexors and stimulation and coordination of the left and right hands. A dynamic wrist-hand and finger extension orthosis was used 4 times a day for 30 minute periods to achieve passive stretching (Fig. 1). A dorsal cockup wrist-hand orthosis was used during the remainder of the day to maintain the corrected position achieved and permit gripping and releasing exercises.

After 4 weeks there was a clear improvement in the function of the intrinsic muscles and

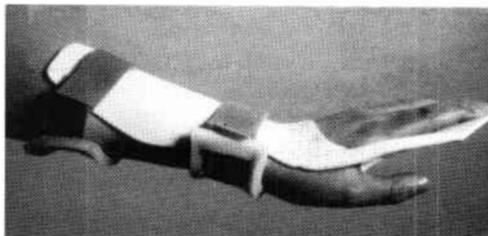


Fig. 2. Static night orthosis.

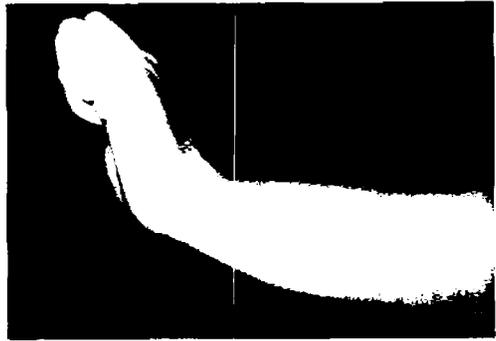


Fig. 3. Wrist dorsal flexion.

lengthening of the finger flexors. There was however no improvement in supination. The patient was discharged from hospital and thereafter treated every day in the outpatient clinic of the department.

After 2 weeks, a static orthosis with 30 degrees dorsal flexion at the wrist was constructed for wear at night (Fig. 2). At that time electromyography indicated reinnervation of the abductor digiti quinti and abductor pollicis brevis muscles.

After 3 months of therapy, the use of both the dynamic extension orthosis and the dorsal cockup wrist orthosis was discontinued.

Following 6 months of recorded clinical and neurophysiological improvement, the frequency of therapy was decreased to 3 times per week and finally stopped. At this time pronation of the forearm measured 10-90 degrees, supination was still not possible. Palmar flexion of the wrist measured 80 degrees, dorsal flexion 40 degrees with full finger extension and 80 degrees with fingers flexed. The force of the finger movements in every direction was 4. There was still a subjective change in sensation. However the patient could use the left hand functionally.

Follow-up

A further clinical follow-up was conducted eight years after the conclusion of therapy. Pronation of the forearm measures 20-80 degrees, supination is still not possible. Wrist dorsal flexion measures 50 degrees with full finger flexion (Fig. 3). The fingers are flexed with the wrist in the neutral position. Full finger extension is possible with the wrist 70-80 degrees palmar flexion. The force of the finger movements is 4.5 except for the little finger,

which is 4. The thumb can be moved within normal limits with normal force and sensation is unimpaired. The patient does not consider that she has any functional impairment.

Discussion

Intracompartmental pressure may increase due to haemorrhage, muscle swelling or oedema caused by decreased arterial input, as occurs in injuries of the brachial artery (Zuker, 1989). A further cause may be external constriction of the compartment volume as may occur with a tight cast (Goldie *et al.*, 1990).

Hypoperfusion leads to ischaemia of the forearm capillaries and muscles. This induces increased permeability of the capillary walls due to the release of histamine-like substances. Oedematous exudate becomes trapped in the inelastic compartments of the forearm. Pressure then increases leading to a further decrease in perfusion and ultimately to ischaemia resulting in a vicious circle of debility (Lapuk and Woodburry, 1987).

Volkmann's ischaemic contracture results from irreversible necrosis of muscle tissue followed by proliferation of fibroblasts within the muscle infarct. Contracture of the fibrotic mass may progress over a period of six to twelve months. The muscles of the deep flexor compartment of the forearm are most susceptible to such ischaemic necrosis and the flexor digitorum profundus muscle is most commonly and severely affected (Gelberman, 1981).

The most common causal factor of Volkmann's contracture in children is a supracondylar fracture of the humerus (Mubarak and Carrol, 1979). The displaced extension-type fracture being particularly notorious (Naidu and Heppenstall, 1994).

Although the incidence is low (Kurer and Regan, 1988), it is important to carefully monitor such patients for the signs and symptoms of compartment syndrome, in order to prevent this destructive process.

The diagnosis of compartment syndrome is based upon clinical findings. However this syndrome can co-exist with arterial or nerve injury and their symptoms overlap. Because of their different treatment requirements, it is important to separate these two entities (Mubarak and Carrol, 1979).

The first and most important symptom in a

developing compartment syndrome is pain which is greater than is normally to be expected from the initial injury. Swelling is the first sign of compartment syndrome (Lapuk and Woodburry, 1987). The pain is persistent, progressive, deep, unremitting and unrelieved by immobilization. It is aggravated by passive muscle stretching. The most reliable test in making the diagnosis is palpable tenseness and tenderness which should verify the diagnosis (Naidu and Heppenstall, 1994).

In the first week of cast immobilization the patient developed persistent, deep pain and oedema of the forearm and hand. She could not sleep because of it.

Unfortunately, compartment syndrome was not diagnosed at this time.

When the cast was removed, the swelling had disappeared, but active movement of the now flexed fingers was possible.

After seven weeks there were clinical signs of significant sensory and motor deficit of the hand, which was now in a claw position. The forearm displayed a classic picture of Volkmann's contracture.

The management of such an established contracture requires restoration of as much function as possible. The choice of treatment depends on the severity of deformity and the time that has elapsed since injury (Gelberman, 1981).

The contracture of this patient was of the moderate or classical type (Naidu and Heppenstall, 1994). The parents however were opposed to surgical treatment, so the patient was treated conservatively.

By admitting the patient to the clinic it was possible to intensify the treatment, that had already started, in a qualitative and quantitative way. Once therapy showed effect and the co-operation of the patient was optimal, treatment was continued in the outpatient department. When therapy was concluded there was a clear increase in joint motion and muscle force and the patient could recommence playing the piano and participated in school volleyball. In the years following this rehabilitation, the rehabilitation specialist tried to conduct an adequate follow-up. The patient and her parents repeatedly declined to attend on the basis that she had no complaints.

Recent examination has however revealed a clear deterioration of function and due to

fibrosis of the flexor digitorum profundus the fingers are in claw position. The patient only uses her thumb and first finger functionally. She no longer plays the piano any more being too busy at school and were she to play, she certainly would not be able to achieve the required finger positions. She has however adapted to the remaining functional capabilities of her left hand. She considers she has no significant problems and is reluctant to consider plastic surgery.

Conclusion

Despite the presence of a fully established moderate Volkmann's contracture and a fifteen week delay in commencement of therapy, the functional result achieved by conservative management and splinting therapy were in every respect acceptable. The therapy was provided by a multidisciplinary team comprising a physiotherapist, an occupational therapist and a rehabilitation specialist.

However, as illustrated in this case, routine and on-going follow-up is essential to achieve a satisfactory final result.

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