

# Forearm Shortening Osteotomy In The Treatment Of Moderate And Severe Volkman's Ischaemic Contracture; Case Series

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## Abstract

VIC originally described by Richard Von Volkman, is a condition arising from muscle ischaemia and necrosis characterized by fibrosis and forearm contracture. Compartment syndrome arising from supracondylar humeral fracture is a common aetiology, with significant cases also arising from tight traditional bone setter's bandages. The severity of VIC based on Tsuge's classification is a significant determinant of treatment choice. Bone shortening osteotomy is a viable treatment option for moderate and severe VIC.

The aim of this case series is to report the functional outcome of forearm shortening osteotomy conducted in our hospital.

**Results** Between July 2018 to July 2022, five (5) children with moderate and severe VIC were treated with forearm shortening osteotomy. Three (3) boys and two (2) girls, M: F (1.5:1) with mean age of 8.6 years±1.8 and mean duration of injury of 9 months±2.2 months were treated. Pre-operatively all patients had poor Disability of the arm, shoulder, hand score (DASH). Post-operatively there was 100% good to excellent outcome in those with moderate VIC and fair outcome in those with severe VIC.

**Conclusion** This case series showed that forearm shortening osteotomy yields good DASH outcome in patients with moderate to severe VIC. This is even more beneficial in patients with VIC associated with non-union or malunion of the forearm bones. The period of post-operative functional recovery is shorter when compared to results in the literature for treatment options such as flexor muscle slide.

**Keywords** Forearm shortening osteotomy, Moderate and severe VIC, Disability of arm, shoulder, hand score (DASH) outcome

Date of Submission: 01-04-2024

Date of Acceptance: 10-04-2024

## I. Introduction

Volkman ischaemic contracture is a claw like deformity named after the German doctor Richard Von Volkman(1). Volkman described a condition involving muscle ischaemia and necrosis with subsequent fibrosis and forearm contracture(2). This condition leads to permanent flexion deformity of wrist and fingers arising from ischemic contracture.

It is a sequelae of compartment syndrome and in children supracondylar humeral fracture is a common cause(3). It is also now recognized that ischaemic contractures can develop from different injuries as long as they are contained in relatively non-distensible compartments(4). A significant cause of compartment syndrome and subsequent VIC is tight bandages employed by traditional bone setters for treating forearm fractures(5). Omid et al(6) highlighted that a high index of suspicion is necessary to avoid missing an impending compartment syndrome and subsequent VIC in supracondylar and forearm fractures.

The sustained pressure within the osteofascial compartment and subsequent ischaemia will result in variable levels of necrosis and fibrosis of the muscles in the superficial and deep flexor compartment(2). Nerves within the ischaemic zone may also suffer damage.

Treatment of patients with VIC is complicated and depends on number of variables(7), amongst which is malunion or non-union of fractures involved(8). The options of treatment based on severity range from physiotherapy stretching, excision of fibrotic tissue, muscle sliding, neurolysis, tendon grafts, and osteotomies amongst others. The severity of the VIC based on the Tsuge classification(9) is a significant determinant of the treatment choice. In those with moderate level of VIC, all fingers will be flexed, with wrist flexion, muscle

atrophy and loss of sensation over median nerve and ulnar. Those with severe level of VIC, usually have clawing of the hand with significant loss of sensation and motor function(9)fig 1.

Flexor muscle slide has been reported as the best treatment for mild to moderate VIC(2,10,11).Bone shortening osteotomy yielded excellent result in a patient with VIC associated with ulnar non-union(8).

There is paucity of literature on the outcome of radius and ulnar shortening osteotomy in the treatment of VIC. Shortening forearm osteotomy restores the function of the forearm and hand by reducing the tension of the muscles and nerves, and improving the alignment and rotation of the bones. The purpose of this case series is to report the functional outcome of forearm shortening osteotomy in moderate and severe VIC.

## II. Materials And Methods

Five (5) patients who had VIC (3 Moderate and 2 severe cases) were treated by forearm shortening osteotomy. Preoperatively the biodata, characteristics of the deformities including aetiology, duration, laterality of the hand affected, function and nerve examination findings including preoperative x-rays were all documented. The disabilities of the arm, shoulder and hand (DASH) was used to assess preoperative and post operative function. The result was rated as a percentage of performance relative to the unaffected hand and was rated as excellent ,good ,fair and poor i.e.( function reduced to 1/4,1/2,3/4 or no function at all)(11) .

Intraoperatively patients had general anaesthesia with prophylactic antibiotics administered. Tourniquet was applied in all cases. Anterior Henry’s incision was used to access the radius and in some cases the incision was extensive to allow for soft tissue release, disinsertion of the flexors and neurolysis especially in severe VIC. The ulnar shaft was exposed via dorsal incision. The radius and ulnar were fully exposed after superficial and deep dissection and shortening osteotomy was performed. The length of bone removed ranged from 2.5 to 4cm depending on the Tsuge’s level of severity. The radius and ulnar were then stabilized with either 3.5mm narrow dynamic compression plate,1/3 tubular plate or rush nail as the case determines. POP back slab was applied to keep the fingers and wrist in position of function until 3 weeks post operatively. All patients had significant contracture of the forearm with only one (1) having fixed wrist contracture and all complied with pre operative and post operative physiotherapy(fig1).

Passive physiotherapy was commenced at 3 weeks post operatively while active physiotherapy was commenced at 6 weeks.

Post operative assessment of functional recovery were conducted during follow-up in the outpatient department at 6 weeks,3months and 6 months using DASH.

## III. Results

Five patients (3 boys and 2 girls) were treated with shortening osteotomy over a period of 4 years from January 2018 to January 2022. M:F ratio was 1.5: 1. Mean age of 8.6years± 1.8years. Mean duration from injury to presentation was 9months±2. 2months.The primary injury was supracondylar fractures in 4 children and radius/ulnar fracture in 1. (Table 1)

Four (4) out the 5 fractures had malunited at presentation with only one healed in an acceptable position. All patients had unorthodox traditional bone setters’ intervention with tight application of splint before they developed VIC.

**Table 1 Characteristics of the patients including treatment and outcome**

CAS E	AGE (YRS)	SEX	AETIOLOGY	PRIMARY BONE AFFECTED	LATERALITY	TSUGE LEVEL OF SEVERITY	DURATION OF VIC	TREATMENT	POST-OP DASH	OUTCOME
SM	7	M	Fall from height	Radius/Ulnar fracture	Right	Moderate	8months	Shortening osteotomy	3/4	excellent
NG	8	F	Fall from height	Supracondylar fracture	Left	Moderate	12 months	Shortening osteotomy	3/4	excellent
UM	10	M	RTA	Supracondylar fracture	right	severe	9 months	Shortening osteotomy+deinsertion +neurolysis	1/4	Fair
FO	7	M	Fall from height	Supracondylar fracture	Right	Moderate	6months	Shortening osteotomy	3/4	excellent
HA	11	M	RTA	Supracondylar fracture	Left	severe	10 months	Shortening osteotomy	1/2	Good

Three (3) children had moderate VIC while two had severe VIC(fig 1). Preoperatively all patients had Poor DASH Score. Post operatively there was 100% good to excellent outcome in those with Moderate VIC, good and a fair outcome in the 2 children with severe VIC(fig 2,3,4). See table 1.



#### IV. Discussion

Shortening forearm osteotomy describes a procedure in which a segment of the radius and ulnar is excised with the aim of restoration of wrist and hand function. This is achieved by reducing the tension of the muscles and nerves.

The higher rate of VIC amongst boys in this case series similar to findings in other studies(2,12) can be attributed to risky plays and other behaviors attributed to boys. The mean age of the children at presentation was 8.6 years $\pm$ 1.82 years much lower when compared with the age in other studies with larger number of patients(2,5,11).The children in our environment are generally tasked with manual responsibilities at a much early age, thereby predisposing them to trauma. Sharma et al(2),reported an average age of 18 years at the time of presentation in a study of 19 patients with VIC . The average time to intervention from injury in our series was 9 months $\pm$  2.23 months slightly higher than the 6 months suggested by Tsuge(9).There was a slight right hand preponderance to VIC which was attributed to the right hand dominance amongst the children ,and this is in keeping with other studies(5,11).

Supracondylar fracture was the most common primary injury accounting for 75% similar to several studies(2,3,11,13,14), however Saaiq(5) found forearm fractures as the most common primary injury in VIC. In this series ,tight bandages employed by traditional bone setters for treating these fractures were reported in all the children and there was similar finding of this unhealthy practice in other studies(2,5).

Several methods of treatment including flexor muscle slide as popularized by Page have been reported in other studies with remarkable outcomes(2,11,15). Stevanovic et al(10) found flexor muscle slide as the best treatment for mild and moderate VIC.Lupuk(16) in a case report showed that neurolysis with infarct excision and tendon transfer can return function in established contracture. Our series showed that the functional outcome as objectively assessed using DASH following forearm shortening osteotomy yielded excellent to good functional outcome in patients with moderate VIC and a fair outcome in those with severe VIC(fig 2,3,4). The outcome is comparable to results from flexor muscle slide as reported in other studies.

L et al(8) in a case report showed an excellent functional outcome for a patient with VIC and atrophic non-union of ulnar. Similar excellent functional outcome with a shorter period of post operative rehabilitation was also seen in our patients with moderate VIC.Neurolysis was done in one of the patients with severe VIC, with none requiring nerve grafting or tendon grafting. Improvement in sensation was seen in all patients in this series.

#### V. Conclusion

There is paucity of literature on the functional outcome of forearm shortening osteotomy in the treatment of moderate and severe VIC.This case series showed an excellent to good DASH outcome in

moderate VIC and a fair DASH in severe VIC with results comparable to other modalities of treatment as reported in other studies. Our study is a series of five (5) patients and it will be impossible to make a statistically significant statement. Though VIC is rare, there is still need for a multicenter collaborative study about the role of forearm shortening osteotomy especially in terms of patient selection.

### **Acknowledgement**

We express our sincere gratitude to all the staff of the Orthopaedic department at Abubakar Tafawa Balewa University Teaching Hospital.

### **Compliance with ethical standard**

**Conflict of interest** -The authors declare that they have no conflict of interest.

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