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Volkman Ischemia Contracture: Muscle Slide Technique

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Each author of this article has encountered all 04 criterions of authorship:
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2. Drafting the manuscript or rewriting it censoriously for important intellectual content.
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ABSTRACT

Objective: To determine the functional outcome of the muscle slide technique in patients with Volkmann's ischemic contracture.
Methodology: Upon clinical presentation, a consultant orthopaedic surgeon diagnosed forty-three patients with severe Volkmann ischemia contracture. The sample size was determined using the WHO Sample Size calculator using the parameters of a 5% significance level, margin of error of 15%, and success rate of 47.70% for the muscle slide method. Clinical evaluation in terms of functionality was done before and after the muscle slide procedure in the 3rd and 6th week post operation.
Results: As per functional outcomes of muscle slide procedure, 26 (60.5%) patients had excellent, 6 (14.0%) had good, 7 (16.3%) had fair, and 4 (9.3%) patients had poor functional outcomes.
Conclusion: Muscle slide technique is an effective technique in robustly managing Volkmann's ischemic contracture.
Keywords: Volkmann's Ischemic Contracture, Muscle Slide Technique, Functional Outcome.

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INTRODUCTION

In 1881, Volkmann was the first to describe the symptoms of forearm muscle ischemia, necrosis, and contracture. Volkmann's contracture is caused by ischemic muscle injury when the capillary closure pressure is exceeded. [1]

Forearm muscle ischemia, necrosis, and contracture were initially described by Volkmann in 1881. When the capillary closure pressure is surpassed, ischemic muscle damage occurs, resulting in Volkmann's contracture. [2]

Muscle contracture of varying degrees can be treated using the muscle slide technique. Both the flexor digitorum profundus and the ulnar flexor are released at their insertions in the interosseous membrane, which is located on the outside margin of the anterior face of the ulna.[3]

A study reported good results for the muscle slide procedure in 49.90% patients of VIC with duration of disability upto 3.3 weeks. [4]

The progression and severity of the contracture will determine the course of treatment. An emergency fasciotomy is performed on a patient with a minor case of VIC. Surgery for this chronic, severe problem includes removal of the diseased muscle, tendon lengthening, sliding of the flexor muscle (Page-Scaglietti surgery), tendon transfer, carpal excision, shortening of the bone, and free muscle transplantation. [5]

Volkmann's contracture is not being given the immediate attention it needs since it is not being recognised. Unfortunately, in our nation and, perhaps, other undeveloped countries, there is no litigation against healers. [6]

This research set out to assess the functional outcomes of the muscle slide technique for people with Volkmann's ischemia contracture.

METHODOLOGY

This descriptive case series was conducted at the Department of Orthopedic Surgery, MTI-Khyber Teaching Hospital, Peshawar, from Sept 2022 to Apr 2023. Ethical approval was sought from the Institutional Research & Ethical Review Board (Ref No. 321/DME/KMC). The sample size was determined using the World Health Organization's sample size calculator, which assumed a success rate of 47.70% for the muscle slide technique, an error margin of 15%, and a significance level of 5%. Nonprobability consecutive sampling technique was adopted for this study.

Study Design: Descriptive Case Series

Place and Duration of Study: Department of Orthopedic Surgery, MTI-Khyber Teaching Hospital, Peshawar, from Sept 2022 to 30 Apr 2023 (09 months).

Inclusion Criteria: Patients of either gender aged 8 to 15 years presented with severe volkmann ischemia contracture diagnosed by consultant orthopedic surgeon on clinical presentation as per Tsuge classification were included in the study.

Exclusion Criteria: Patients with mild to moderate Volkmann ischemia contracture were excluded.

All participants provided written informed permission following a thorough explanation of the study's purpose and procedures. Consultant orthopaedic surgeon identified severe Volkmann ischemia contracture on clinical presentation (all forearm flexor and extensor muscles affected; significant paralysis of hand). Elbow, wrist, and hand of all patients were subjected to AP and lateral X-ray taken before surgery. The surgeon made an incision over the affected area to access the muscles and tendons. The contracted muscles and tendons were carefully released from any adhesions or scar tissue that may be restricting their movement. In some cases, the surgeon may perform a lengthening procedure to increase the overall length of the affected muscles and tendons. After releasing and/or lengthening the muscles and tendons, the incision is closed using sutures or staples. Post-operative protocol for patients undergoing surgery for Volkmann's contracture involved, immobilization using a splint or cast to protect the surgical site and allow for proper healing, physical therapy was employed as it plays a crucial role in rehabilitation following surgery. It helps improve range of motion, strength, and function of the affected muscles and tendons. Patients were prescribed pain medications to manage post-operative discomfort. The Disabilities of the Arm, Shoulder, and Hand (DASH) score was used for the clinical examination. [7] To evaluate the functional results before and after the muscle slide procedure in the 6^{th} and 12^{th} week and were labelled as excellent (0-20 score), good (21-40 score), fair (41-60 score), and poor (61-100 score).

The data was entered and analysed using SPSS 23.0 (Statistical Package for the Social Sciences). Patients' demographic and clinical characteristics were described using descriptive statistics. Results of the intervention were analyzed using the chi-square test, with a functional outcome being considered significant if the p-value ≤ 0.05.

RESULTS

A total of forty-three patients were included in this study. Mean$\pm$SD for age, duration of disability, Pre-OP and Post DASH score was 16.88$\pm$8.710 years, 3.19$\pm$1.029, 83.25$\pm$3.691 score and 21.23$\pm$25.405 score respectively (p-value < 0.001). 34 (79.1%) patients were recorded in $\leq$ 20 years age group while 09 (20.9%) patients were recorded in > 20 years age group. 25 (58.21%) male and 18 (41.9%) female patients were recorded. (Table-I).

Table-I: Demographic Characteristics of Study Participants with Volkmann ischemia contracture (n=43)

Quantitative Variables	**Mean$\pm$SD**	**p-value**
Age (Years)	16.88$\pm$8.710	
Duration of Disability (Weeks)	3.19$\pm$1.029	
Pre-Op DASH (Score)	83.25$\pm$3.691	< 0.001
Post-Op DASH (Score)	21.23$\pm$25.405	
Qualitative Variables		
Age Groups, n (%)		
• $\leq$ 20 Years	34 (79.1%)	
• > 20 Years	9 (20.9%)	
Gender Groups, n (%)		
• Male	25 (58.21%)	
• Female	18 (41.9%)	

Fig-1: Pre Op Clinical Picture

Fig-1: Per Op Clinical Picture

Fig-3: Post Op Clinical Picture

Table-II: Functional Outcome of Muscle Slide Procedure among Study Participants with Volkmann ischemia contracture (n=43)

Functional Outcome, n (%)	
• Excellent	26 (60.5%)
• Good	6 (14.0%)
• Fair	7 (16.3%)
• Poor	4 (9.3%)
• Total	43 (100.0%)

As per functional outcome of muscle slide procedure in study participants, 26 (60.5%) patients had excellent, 06 (14.0%) patients had good, 07 (16.3%) patients had fair while 04 (9.3%) patients had poor results (Table-II).

DISCUSSION

The purpose of this research was to use the Disability and Health Outcomes Scale (DASH) to assess the efficacy of the muscle slide technique in treating Volkmann's ischemia contracture.[8] There is a lack of information on the functional outcome of the muscle sliding method despite the high prevalence of Volkmann's ischemic contracture (VIC) in our population. We used the muscle slide technique on 43 individuals with severe Volkmann's ischemic contracture. Clinical follow-up was performed on all patients in the third and sixth week after surgery.

There were certain differences in comparison with other studies [9]. This was a descriptive case series whereas most of the studies were retrospective in nature. In this study we included forty-three patients. Mean+SD for age was 16.88$\pm$8.710 years. 34 (79.1%) patients were recorded in $\leq$ 20 years age group while 09 (20.9%) patients were recorded in > 20 years age group. 25 (58.21%) male and 18 (41.9%) female patients were recorded. This study's findings, which showed that men were overrepresented, were supported by other

research because men are more likely to engage in high-risk behaviors that put them at greater risk for experiencing trauma for the first time. According to the literature [10], 10.07–60% of VIC instances result from supracondylar fractures, while 54.6% result from fractures of both forearm bones. The presence of gas gangrene and osteitis in some of our patients was extremely rare when compared to cases in the literature. X-rays played a crucial role in this study, demonstrating osteitis caused by infected Volkmann Ischemic Contracture and finding displaced fractures and associated lesions. Although not typically used for initial diagnostic purposes, imaging techniques like MRI and CT may prove useful in the identification of VIC.

In terms of therapy, Ultee disagrees with authors like Page Scaglietti, who favours neurolysis for Griffart et al. [16], and Meena, who favours free muscle transfer or neurolysis-tenolysis. Based on the severity of their lesions, we included patients. For severe cases of compartment syndrome resulting from VIC, Roy Camille [4] recommends an anterior fasciotomy as the preferred emergency procedure.

Assessment scores in research varied from 0% to 47.70%, on average coming in at 14.48%. The study included 12 mild cases and 4 severe cases. The median age dropped to 18 since nine individuals were younger than 15. People missed work for an average of 2.7 weeks. In this part, a 57-year-old woman with VIC and gas gangrene infection stands out as the greatest case study. Treatment success was high (13.6%) despite the seriousness of the lesions. In contrast to these findings, we included patients of severe VIC with mean$\pm$SD for age, duration of disability, Pre-OP and Post DASH score was 16.88$\pm$8.710 years, 3.19+1.029, 83.25$\pm$3.691 score and 21.23$\pm$25.405 score respectively (p-value < 0.001). 25 (58.21%) male and 18 (41.9%) female patients were recorded. (Table-I). 26 (60.5%) patients had excellent, 06 (14.0%) patients had good, 07 (16.3%) patients had fair while 04 (9.3%) patients had poor results (Table-II). Ischemic Volkmann contractures brought on by anaerobic or common germ infections respond well to muscle slide treatment, as shown here.

Muscle sliding enhances finger sectorial mobility, allowing for reliable hand use even after muscles have been contracted. Paralysed tendons could need surgery such nerve grafting, tendon grafting, or reinnervation. Patients with severe contractures often need sophisticated therapy via free muscle transfer since wrist extensor muscles and tendons are often not available as tendons transfers due to their involvement in the initial phase. The study had 21 positive findings and 11 unfavourable findings. 26 patients reported great results, 6 reported good results, 7 reported fair results, and 4 reported bad results after receiving a muscle slide treatment, for an overall average of 50.30 %. (Table-II). Seven patients who underwent the Page-Scaglietti procedure 63.6 months after their injury and were reported to have successful outcomes by Griffart et al. [16]. Free transfer of innervated microvascular muscles and neurolysis-tenolysis or tendon transfer were found to be the most effective techniques by Ultee et al. [7] in 2005. After suffering an injury, patients waited an average of 32.84 months to receive care.

In a 2016 study, Meena et al. [16] employed neurolysis of the median and ulnar nerves as a therapy. Patients in the first group to acquire VIC all underwent surgery within six months of diagnosis. Patients in the second group were diagnosed with Volkmann's contracture and underwent surgery more than six months after their symptoms began. Both groups improved in terms of motor and sensory recovery, and there was no discernible difference between them. Saaiq [14] released a data set containing 37 patients from the year 2020. Traditional methods of setting forearm fractures were the most common cause. The median and ulnar nerves were routinely severed, and tendon transplants, muscle excision, tenolysis, and neurolysis were commonplace. In the majority of these operations, a tendon was transferred.

There is some debate over how and when to treat already-developed contractures. Tsuge [20] recommends waiting for 6 months, while Seddon [13] recommends a shorter time frame of 3 months. Meena et al. [15] concluded that the timing of operations had no bearing on the health of their patients. Due to a lack of research time, we limited our follow up to the third and sixth week, even though an early response is indicated to prevent nerve weakness and increased joint stiffness following a surgical procedure for a retraction.

Ischemia can have devastating implications if not diagnosed and treated in time, yet traditional healers still provide alternate treatments. Volkmann's contracture is not being given the immediate attention it needs since it is not being recognized. Unfortunately, neither our country nor any other poor country I can think of has any legal recourse against healers.

As a result, we should constantly stress prevention over treatment. Patients being treated for

limb fractures and soft injury with bandages and tight dressings should be constantly monitored for signs of compartment syndrome and VIC. In conclusion, an open repair, regardless of technique, is recommended by most authors [16,17,18].

CONCLUSION

Involvement of the muscle slide technique in the management of Volkmann's ischemic contracture is helpful, but the success of treatment ultimately depends on the reversibility of the lesions and the prognosis, as this is a significant condition for which treatment is chosen based on the severity of the lesions.

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Conflict of Interest
This study has no conflict of interest to declare by any author.

Authors Contribution
Following authors have made substantial contributions to the manuscript as under:

MS & MI: Conception, study design, drafting the manuscript, approval of the final version to be published.

FW & PS: Data analysis, data interpretation, critical review, approval of the final version to be published.

MA & MA: Data acquisition, critical review, approval of the final version to be published.

ZS & HR: Proof readings, write-up, approval of the final version to be published.
Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Limitations of Study
Due to the rarity of the condition being studied, the study's sample size was rather limited. Since this was a case series study with limited patient follow-up time, it's possible that some important results were overlooked.

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