

# The Beneficial Effect of Functional Electrical Stimulation of Miller Fisher syndrome (MFS) with Special Context to Guillain-Barré Syndrome Rehabilitation of a 25-year-Old Patient – A Systematic Review and Meta-Analysis

## Case Report

Borah AK<sup>1\*</sup>, Goswami P<sup>2</sup> and Saikia H<sup>2</sup>

<sup>1</sup>Department of Neuro-Physiotherapy, Mahatma Gandhi University, District Ri Bhoi, Meghalaya, India

<sup>2</sup>Department of Physiotherapy and Orthopedic Rehabilitation, Sanjevani Hospital, Maligaon, Guwahati, Assam, India

\*Corresponding author: Arup Kumar Borah, Department of Neuro-Physiotherapy, Mahatma Gandhi University, District Ri Bhoi, Meghalaya, India. E-mail Id: [barup614@gmail.com](mailto:barup614@gmail.com)

Article Information: Submission: 14/04/2026; Accepted: 05/05/2026; Published: 07/05/2026

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### Abstract

Miller Fisher syndrome is a rare and atypical variation of Guillain-Barré syndrome, which includes the clinical triad of areflexia, ataxia, and ophthalmoplegia. Miller Fisher syndrome is commonly associated with the involvement of the lower cranial and facial nerves. Miller Fisher syndrome is one of the types of Guillain-Barré syndrome. Guillain-Barré syndrome has been defined to be the foremost incapacitating form of neurological disease following the disease polio. Guillain-Barré syndrome is a broad category that encompasses several types of acute immune-mediated polyneuropathies, the most common of which is acute inflammatory demyelinating polyradiculoneuropathy. It is considered part of the continuum of immune-mediated acute polyneuropathies, alongside GBS and Bickerstaff brainstem encephalitic (BBE). Charles Miller Fisher (1913-2012) first formally described this syndrome in 1956, and it has been recognized as a distinct clinical entity within the GBS spectrum. We apply Functional Electrical Stimulation method of externally controlling muscles when signals from the brain can no longer control movement. This can happen after a spinal cord injury, stroke or neurological disorder such as multiple sclerosis. FES improves the quality of life (QoL) for patients with neurological disabilities across the globe. We also describe the patient's clinical course, diagnostic method, and therapy. The study demonstrates the value of early detection, quick action in treating Miller Fisher syndrome, and the possibility of full recovery with adequate therapy. Techniques utilized in physical therapy emphasize performing everyday tasks along with strengthening muscles. Miller fisher syndrome has a generally good prognosis, with most patients achieving full or near-full recovery within 8 to 12 weeks, and usually within 6 months. Recovery involves the gradual reversal of ataxia (loss of balance), ophthalmoplegia (eye movement issues), and areflexia (lost reflexes). Early treatment with IVIg or plasmapheresis is key.

In this paper we study a case report of a 25-year-old male patient who displayed the characteristic symptoms of Miller Fisher Syndrome. We also investigate the patient's clinical course, diagnostic method, and therapy. Hence, this case demonstrates the value of early detection, quick action in treating Miller Fisher syndrome, and the possibility of full recovery with adequate physiotherapy treatment. Techniques applied in physical therapy emphasize performing everyday tasks along with strengthening muscles.

**Categories:** Neurology; Pain Management; Physical Medicine and Rehabilitation.

**Keywords:** Miller fisher syndrome; Guillain-Barré syndrome; Physical recovery; Neurological recovery; Pain control

## Abbreviations

MFS – Miller Fisher Syndrome; GBS – Guillain - Barré Syndrome; AIDP – Acute Inflammatory Demyelinating Polyradiculopathy; SCAT 3/5 – Sport Concussion Assessment Tools – 5 steps Neurological Screen; EMG – Electromyography; EEG – Electroencephalography; DR – Direct Response (facial nerve, motor); NC – Nerve Conduction.

## Purpose

To describe a diagnostic approach and rehabilitation, the management a rare case of Miller Fisher Syndrome.

## Objectives

Miller Fisher syndrome objectives focus on early recognition of the clinical triad – ataxia, areflexia and ophthalmoplegia and prompt management to improve patient outcomes. Key goals include distinguishing MFS from other Guillain-Barré syndrome variants, confirming diagnosis with anti-GQ1b antibodies, initiating immune-targeted therapy, and preventing respiratory complications. Identify treatment considerations including FES for patients with Miller Fisher syndrome. Review the abnormal findings found upon evaluation of Miller Fisher syndrome compared to those found in other forms of Guillain-Barré syndrome.

## Case presentation

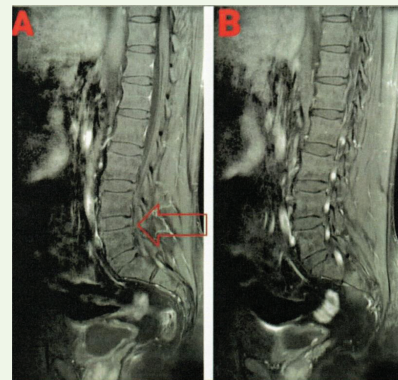
### Patient information

A 25-year-old young boy came to Sajeevani Hospital, Guwahati, Assam India with a chief complaint of bilateral symmetrical weakness in both upper and lower extremities over the preceding 45 days, with more of an impact on his legs than his arms. The patient also had history of chronic cough for 2 weeks before the onset. Patient noticed imbalance and tendency to fall on either side during walking. The patient had no relevant medical history of tuberculosis, diabetes or hypertension. Neurological examinations finding showed ataxia gait when the patient performed tandem gait test, concussion protocols (SCAT3/5). The assessment and inquiry confirmed that the patient was diagnosed as Miller Fisher syndrome (MFS), a variant of Guillain-Barré syndrome. But, the patient was admitted and to shift for specialized care in the neuro-intensive care unit (NICU) before being moved to the general ward. Furthermore, the patient was referred to neurophysiotherapy for further improvement in quality of life (QoL).

### Clinical Findings

As MRI findings and shows enhancement of the cauda equina nerve roots, consistent with the Landry-Guillain-Barre syndrome spectrum. The examination process started only after obtaining parol-contract. The patient's head end is raised to 30 degrees in a supine lying position. The patient was conscious and followed command properly. His body type was ectomorph. The patient relied on his auxiliary muscles for respiration since he had trouble breathing. Both eyes showed signs of ptosis. Upon examination, ophthalmoplegia was determined by the paralysis of the ocular muscles. Both deep and superficial reflexes remain unaltered. In the lower limb, superficial reflexes were reduced while deep reflexes were not elicited. Thus, clinical outcomes showed that both lower limbs had a loss of muscle strength. Compared to the bilateral upper limb weakness, there was

a greater lower-limb weakness. The patient was unable to do basic everyday tasks including sitting, standing and walking due to severe exhaustion as well as physical pain. In the upper limb, superficial sensations of touch, pain, and warmth were determined to remain intact, but they were decreased in the lower limb. Now, the tone grading scale indicating that the upper limb tone was normal, and on the lower limb, the tone was decreased (Table 1). Grade-2 power was found in both lower The MRI report is shown in (Figure 1). (Table 4) shows physiotherapy intervention. (Figure 2), (Figure 3), (Figure 4), and (Figure 5) show the exercises performed by the patient. (Figure 6) and outcome measures. limbs and during manual muscle testing (Table 2). (MMT). The supinator jerk, triceps, and biceps There was no response on the knee and ankle (Table 3), all responded normally to reflex tests. The bilateral lower limb's hamstring and tibialis anterior muscles were found to be tight.



**Figure 1:** MRI scan showing (A) disc desiccation at the L4-L5 disc level, and (B) conus medularis and roots of the cauda equina depicted enhancement on contrast, raising the possibility of Guillain-Barré syndrome



**Figure 2:** Patient performing straight leg raises (SLR)



**Figure 3:** Patient performing Pelvic Bridging



Figure 4: Tendon Achilles stretching of the patient



Figure 5: Joint approximation for the Hip Joint Region

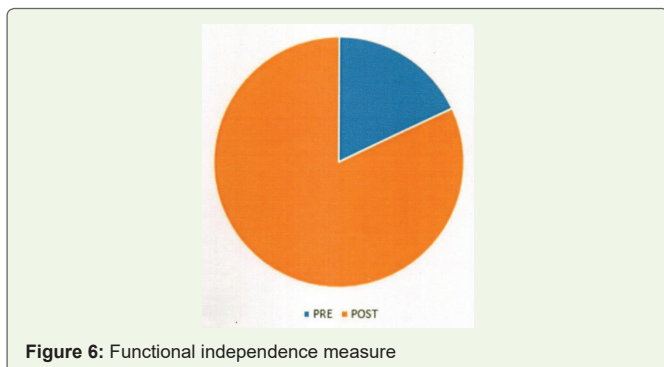


Figure 6: Functional independence measure

Table 1:

Initial Phase	Passive movements and gentle stretching to maintain joint flexibility and prevent contractures due to weakness.
Strengthening Exercises	Targeted exercises for weakened muscle groups, including core muscles, back extensors, and lower extremities to improve functional capacity.
Balance and Coordination Training	Exercises aimed at treating ataxia (lack of coordination) to improve stability and prevent falls.
Functional Mobility and Gait Training	Techniques to improve walking, sitting, standing, and climbing stairs.
Range of Motion	Active and passive exercises to address reduced movement from paralyzed or weakened muscles.
Respiratory Therapy	Breathing exercises to improve lung capacity, particularly if diaphragm involvement occurs.

Table 2: Muscle Tone

Muscle Tone	Right	Left
Upper limb	2*	2*
Lower limb	1*	1*
<b>Lower limb</b>	<b>Left</b>	<b>Right</b>
Tone	Normal	Decreased
Hip flexion	5/5	3/5
Extension	5/5	2/5
Adduction	5/5	4/5
Abduction	5/5	4/5
Knee flexion	5/5	4/5
Extension	5/5	2/5
Ankle plantar flexion	5/5	5/5
Dorsiflexion	5/5	5/5
Reflexes patellar	++	+
Calcaneal	++	++
Babinski sign	Down going	Down going
Coordination foot tap	† NAD	† NAD
Heel sign test	† NAD	Not assessed due to weakness

2\* indicates normal tone,  
1\* indicates diminished tone  
†NAD indicates not assessed due to weakness.

Table 3: Bilateral lower limb Manual muscle testing (MMT) (as per Medical Research Council Grading)

Muscle	Right	Left
Hip flexion, L2-L3	2/5	2/5
Knee extension L3-L4	2/5	2/5
Knee flexion L5-L1	2/5	2/5
Ankle dorsiflexion L4-L5	2/5	2/5
Ankle plantar - flexion S1-S2	2/5	2/5
Hip extension L5-S1	2/5	2/5
† Bilateral assessment Grade 0: No contraction Grade 1: Flicker of contraction, no movement Grade 2: Full range of motion with gravity eliminated Grade 3: Full ROM against gravity Grade 4: Full ROM against gravity and moderate resistance Grade 5: Normal; full range of motion against gravity and maximum resistance	Always test both limbs to compare for symmetry	Nil

Table 4: Lower limb reflexes

++	Normal
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### Introduction

Functional Electrical stimulation (FES) systems can radically change people’s lives. They increase a person’s functional ability, thereby improving quality of life. The patient’s new found ability to participate more actively in society reduces their isolation and dependence on others. Miller Fisher syndrome is a rare disorder that causes your immune system to attack nerves, usually starting in your face. It can affect the nerves that control your eye muscles, so you may have trouble moving your eyes. But, MFS also can cause problems with your coordination and reflexes. Symptoms usually follow a viral or bacterial infection. It is more common in Asian descent. MFS affects males twice as often as females. Miller Fisher syndrome

Table 5

Problem	Cause	Therapeutic goals	Treatment
Patient and caregiver education	Muscle performance is reduced	To make the patient functionally independent	To describe the at home workout regimen in simple terms and to describe all the red flags as well as dos and donot
Reduce air-entry into the lungs	Diaphragm and intercostal muscle weakness	To improve vital capacity	Thoracic expansion deep breathing, purse lips breathing, reduce panic, keep airways open, diaphragmatic breathing, and glossopharyngeal breathing exercises
Preventing pressure ulcers	Prolonged immobility	To maintain proper skincare	Apply cushioning for positioning. Shift every 2-3 hours. Instructions for pressure-relieving techniques.
Decreased range of motion	Due to weakened muscle	Stretching and active range of motion exercises will engage the agonist and muscle spindle, enhance ROM and maintain joint integrity	After engaging in active-assisted workouts, perform passive ROM exercises, active ROM exercises for both lower limbs, and stretch
Weak back extensor and abdominals	Because of weakened abdominal muscles	To improve the strengthening of pelvic muscles	Pelvic bridging.
Difficulty in breathing	Diaphragm involvement	To improve lung capacity	Incentive spirometry with inspiratory hold.
Weakened lower extremity muscles	Decreased nerve conduction and weakness as a result of the hospital stay and illness	It will enhance the power and functionality of muscles	Lower limb strength exercises with weight cuffs (starting at 0.5 kg and working up to 1). Simultaneous strengthening of the hips and quadriceps.
Postural deviation	Prolonged immobilization and bed rest	After 2 weeks, any variation in posture will come back to regular.	Postural correction exercises, chest binders, positioning, and use of foam mattress.
Proprioceptive impairment	Bed ridden for a longer period of time	In 3 weeks proprioception will follow. But on 3to 4 weeks gait training; the person may be able to walk with ease and at a regular cadence covered with the proper training.	Joint approximation and joint compression, along with proprioceptive trainer training
Abnormal gait	Extended hospital stays, preference for proprioception	After 3 to 4 weeks of gait training, the patient can walk easily and have a normal cadence	Side leg raises, toe and heel raises, ankle dorsiflexion, single-leg stance, gait training, seated marching, squatting, and knee-to-chest movements are some of the workouts that target the quadriceps.

is not contagious, so it doesn't spread from person to person. This syndrome is very rare. It affects about 1 to 2 people per 1,000,000 people worldwide.

MFS usually follows an infectious trigger, most commonly *Campylobacter jejuni*, *Haemophilus influenza*, or viral agents. Molecular mimicry leads to autoimmune attack on gangliosides, particularly GQ1b, explaining the cranial and sensory involvement. MFS predominantly affects the cranial nerves III, IV and VI, as well as proprioceptive pathways. Although, initially alarming, MFS has a favourable prognosis, with most patients recovering within 8-12 weeks. But, severe forms may involve limb weakness or respiratory compromise, blurring distinctions with GBS variants.

Neurological symptoms in Miller Fisher Syndrome have been associated with anti-GQ1b IgG antibodies. Generally, it takes 10-15 weeks for signs and symptoms to improve completely, and almost all patients have a good prognosis. Oculomotor, dorsal ganglion neurons, and muscle spindles all express the GQ1b ganglioside [1]. Ataxia, ophthalmoplegia, paradoxical hyperreflexia and alternate consciousness are all symptoms of Bickerstaff brainstem encephalitis. Fisher's syndrome has been associated with antibodies to ganglioside Q1b [2]. An upper respiratory or digestive tract disorder frequently comes before this severe polyneuropathy. Thus, 85-90% of all Miller Fisher syndrome patients, there is an antiganglioside antibody known as anti -GQ1b, which is self-reactive to the GQ1b ganglioside component of the nerve [3]. The most prevalent triggering infection is caused by *Campylobacter jejuni*, this associated illness with MFS,

Bickerstaff brainstem encephalitis is characterized by a triad of acute bilateral ophthalmoplegia, ataxia and encephalitis, with overlap with some forms of Guillain-Barré syndrome [4].

Acute inflammatory immune mediated polyradiculopathy, diminished or absent myotatic reflexes, distal areflexia and proximal hyporeflexia, and albumin cytologic dissociation are diagnostic criteria for Guillain-Barré syndrome. However, symptoms typically include tingling, diminished strength of the muscle cell, as well as discomfort [5]. Often the earliest noticeable signs of the Guillain-Barré syndrome are symmetrical paresthesia that grows distally. The four main subtypes of this condition are acute motor axonal neuropathy, acute motor and sensory axonal neuropathy, and acute inflammatory demyelinating polyradiculoneuropathy. Four studies conducted in Western nations indicated in winter high, whereas research from Northern China, India, Bangladesh and Latin America indicated a summer peak [6].

On the other hand, the prevalence of Guillain-Barré syndrome varies from 0.6 to 2.66 per 100,000 annually; according to a Meta-analysis and men appear more likely than women to get Guillain-Barré syndrome [7]. But, the autoimmune illness of Guillain-Barré syndrome is diverse. It affects 0.4 to 1.7 cases per million people annually [8]. Plasma exchange (PE) is considered as the best option and first-line therapy method for gastrointestinal (GI) bleeding syndrome. Individuals have experienced shorter times on ventilator assistance, quicker healing and earlier mobility due to the benefits of plasma exchange. The term multidisciplinary-care adhering to Guillain-

Barré syndrome implies healthcare administration involving more than two specialists such as healthcare, physiotherapy, occupational therapy, nutritional counseling and additional healthcare providers [9].

Even though physicians might not regularly encounter individuals with Guillain-Barré syndrome on daily basis, such individuals and the family demands seen substantial [10].

### Treatment protocols

Initiate immunotherapy promptly, usually with intravenous immunoglobulin (IVIg) or plasmapheresis as these are the standard of care.

Recovery – Most patients' recovery fully within 8-12 months.

Effects on Functional Electrical stimulation (FES)-Functional electrical stimulation has demonstrated potential to improve eye movement disorders (ophthalmoplegia) faster than conventional, non-stimulated therapy.

**Case Evidence** – A 25 years old male patient with severe MFS showed improved ocular motility within 10 days TENS treatment, compared to an usual 5 months recovery.

**Mechanism** – we apply Electrical stimulation as well as functional electrical stimulation (FES) may help reestablish nerve-muscle connections (neuro-modulation) and prevent atrophy.

### Method – management

Miller Fisher syndrome is mainly treated with adequate supportive care, pain control, respiratory support as needed and immunotherapy. Although used in the past, oral or intravenous (IV) steroids are no longer recommended in the treatment of GBS or MFS because they are ineffective. Corticosteroids may slow recovery from GBS and they are recommended only in the setting of neuropathic or radicular pain. IV immunoglobulin (IVIg) and plasma exchange (PE) are effective treatments for Guillain Barré syndrome and severe cases of Miller Fisher syndrome.

**Post-Operative and Rehabilitation Role** – Physical Therapy treatment is essential for managing *ataxia* and muscle weakness.

A patient discharged with GBS or MFS may need a lengthy and intense program of physiotherapy to recover function. Complete recovery is dependent on many factors, including the severity of neurological deficits at onset, the age of the patient, complications, motivation, and goals of the patient, among others.

A thorough physical and occupational therapy assessment in the hospital is essential to identify the patient's needs and goals of therapy. Patients with GBS and MFS frequently begin acute care and Physiotherapy treatment in the intensive care unit, then progress to a sub-acute setting in a rehabilitation department or outside nursing/rehab facility and eventually translate to home-based or outpatient therapy. The assessment includes a patient/caregiver interview, sensory function, skin inspection, testing joint range motion, manual muscle testing, functional testing (e.g., ADL/IADL pre and post-illness), mobility, respiration (e.g., vital capacity and inspiratory force), autonomic dysfunction, and endurance.

**Task Oriented Training** – Functional Electrical stimulation combined with task-oriented training is highly effective for regaining functional movement, similar to its use in other polyneuropathies.

**Safety** – Nerve stimulation and functional electrical stimulation are generally considered a safe, adjunct therapy to standard care.

### Symptoms of Miller Fisher Syndrome

#### To prevent Miller Fisher Syndrome

There's no way to prevent Miller Fisher syndrome. But you can take steps to reduce your risk of getting a viral or bacterial infection. Be sure to:

Outlook for someone with Miller Fisher syndrome:

The outlook for people who receive treatment for Miller Fisher syndrome is good. It's rarely fatal and usually doesn't cause any serious or long-term health complications. Most people recover within two to six months.

#### Clinical aspects of Miller Fisher syndrome (MFS)

A lumbar puncture was performed to examine the cerebrospinal fluid (CSF). The ultimate diagnosis of Miller Fisher syndrome, a variant of Guillain-Barré syndrome, was made possible by the lumbar puncture (lower back, usually L3/L4 below the spinal cord itself) and clinical findings. The complete blood count was examined. MRI reports show in (Figure 1).

#### ata availability statement

The original contributions presented in the study are included in the article / supplementary material; further inquiries can be directed to the corresponding authors.

#### Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

#### Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be constructed as a potential conflict of interest.

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### Discussion

Diagnosis of Miller Fisher syndrome in this patient is supported by the clinical findings of acute onset ophthalmoplegia, ataxia and areflexia following an episode of upper respiratory tractus infection. Although analysis CSF and serological testing anti GQ1B antibodies was not performed, but electromyography finding of this patient supported our clinical diagnosis. Miller Fisher syndrome has a positive prognosis, and the decision to initiate immunomodulatory therapy should be guided by the patient's overall condition.

The patient had shown gradual improvement in symptoms including power, ataxia, ophthalmoplegia at fourth and eight week follow up.

As a result of its unique manifestation and uncommon evaluation, the above neurological case presents significant challenges. The surveillance of complications and crucial medical care among those diagnosed with Guillain-Barré syndrome has given way to a newly developed intensive approach (plasma exchange and intravenous immunoglobulin infusion), which reduces this condition's course and improves outcomes, particularly among individuals with severe illness. This approach for handling followed earlier research that suggested treating the root cause of the disease, treating acute neuropathy along with its consequences, and promoting the individual's sustained recovery which constitute the most important aspects of managing Guillain-Barré syndrome. Research has demonstrated to benefit critically ill patients in intensive care units, and speedy rehabilitation promotes a rapid cure. Vital signs showed extraordinary improvement, primarily attributable to the team and intensive care unit scheduled interventions [11].

Atypical Guillain-Barré syndrome is a rare version of ataxia, ophthalmoplegia, and areflexia that complies with the medical range established by Cullier. GQ1b antibodies found in the fibers of oculomotor nerves, neurons of the posterior spinal root ganglia, and neuromuscular spindles elicit an across-reaction that results in Miller Fisher syndrome following an episode of digestive problems as well as pulmonary infection or immunization [12].

Etiology of this case is likely viral (both influenza-like and gastrointestinal), which might cause a reaction of autoimmune origin that could, in a few instances, result in Guillain-Barré syndrome along with the uncommon Miller Fisher syndrome [13].

Specific subgroups of Guillain-Barré syndrome can express distinct antiganglioside indicators. The characteristic Miller Fisher syndrome outcomes for our patient's situation had been bilateral ophthalmoplegia, hyporeflexia, and antiganglioside positive along with elevated cerebrospinal fluid. Depending on when the lumbar puncture is done, albumin-cytological separation is the usual cerebrospinal fluid finding for Guillain-Barré syndrome [14].

Furthermore, common prior occurrences among patients incorporate illnesses, especially gastrointestinal and infections of the airways nearly (83%). Thus, this clinical case study provides an example of how physiotherapy can help individuals with Miller Fisher syndrome Guillain-Barré syndrome (GBS) achieve an independent return. The severity and duration of symptoms are brought into focus, making a conventional treatment strategy more challenging to follow, and calls for additional study into how innovative therapies affect healing [15].

The functional state has been evaluated applying the Hughes disability scale, whereas the muscle power was evaluated using the Medical Research Council (MRC) grades [16]. Presently, there hasn't been any epidemiological research that explicitly evaluates the occurrence and rate of Miller Fisher syndrome [17]. Bersch et al. studied that based on task-focused functional training and a 16 week intensive functional electrical stimulation; the outcomes show that

a patient with chronic Guillain-Barré syndrome with hyperreflexia can enhance their fine motor abilities [18]. It is possible to reach early independent functioning with the right medical care and physiotherapy treatment [19,20].

## Conclusion and direction to future research

Mildly affected Guillain-Barré syndrome patients may still have considerable problems in mobility at three and six months after onset of the disease. The positive effect of PE (plasma exchange aka, plasmapheresis). It is a primary first-line immunotherapy treatment used to treat this rare neurological disorder by filtering harmful autoantibodies out of the blood [21].

### Manual Muscle Testing (MMT)

SI No	Grade	Performance
1	Grade - 0	No contraction
2	Grade -1	Trace contraction (no movement)
3	Grade - 2	Poor contraction (movement, no resistance)
4	Grade -3	Fair contraction (movement against gravity)
5	Grade -4	Good contraction (movement against gravity and resistance)
6	Grade -5	Normal contraction (full strength, range of motion)
	Plus/Minus Grades	(+) indicates slightly stronger than grade and (-) indicates slightly weaker than grade
	Grade 2+	(slightly stronger than poor contraction)
	Grade 3-	(slightly weaker than fair contraction)

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