

## Manipulation Under Anesthesia (MUA): A Comprehensive 30-minute Primer

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### Abstract

Manipulation under anesthesia (MUA) is a multidisciplinary method for treating musculoskeletal conditions. Although several medical experts practice it, only those having experience in MUA research and accreditation in the technique are supposed to perform MUA procedures. MUA helps regain the optimum range of motion (ROM). It provides the intended result in 2 – 4 sessions. It is based on improving mobility in gradual amounts, rather than large amounts, each day to achieve desired effects in ROM and pain reduction. Although the literature supports the positive results achieved from MUA, data on treatment effectiveness are limited. Furthermore, published studies are often poor in methodological rigor and vary across domains, preventing generalization. This review discusses the history and analyzes studies on the benefits and standardization of diagnosis, procedure, certification, and treatment of MUA.

**Keywords:** Increase Range of Motion; Low Back Pain; Natural Pain Relief; Spinal Manipulative Therapy; Spinal Disorders; Treatment for Frozen Shoulder

### Abbreviations

FS: Frozen Shoulder; MUA: Manipulation Under Anesthesia; ROM: Range of Motion; SMT: Spinal Manipulative Therapy; TKA: Total Knee Arthroplasty

### Introduction

Manipulative treatment appears to transcend conventional treatment. Many cave artworks, as early as the Aurignacian era (17,500 BCE), depicted spinal procedures. The Chinese (2700 BC) and Greeks (1500 BC) documented the use of spinal manipulative therapy

(SMT). Manipulative treatment does not appear to have a single origin; it was performed by ancient Egyptians, Syrians, Japanese, Hindus, Babylonians, and Buddhists. Native American or Indigenous people even American Indian pictographs indicate that cultures as diverse as Mesoamerican Indians, Aztecs, Winnebago, and Sioux were familiar with the technique [1].

MUA was established in the early 20<sup>th</sup> century as a specialized method that evolved naturally from therapeutically effective SMT [2]. Various versions of MUA have been used since 1930, with orthopedic surgeons and osteopathic practitioners employing this method between the 1940s and 1950s [1,3].

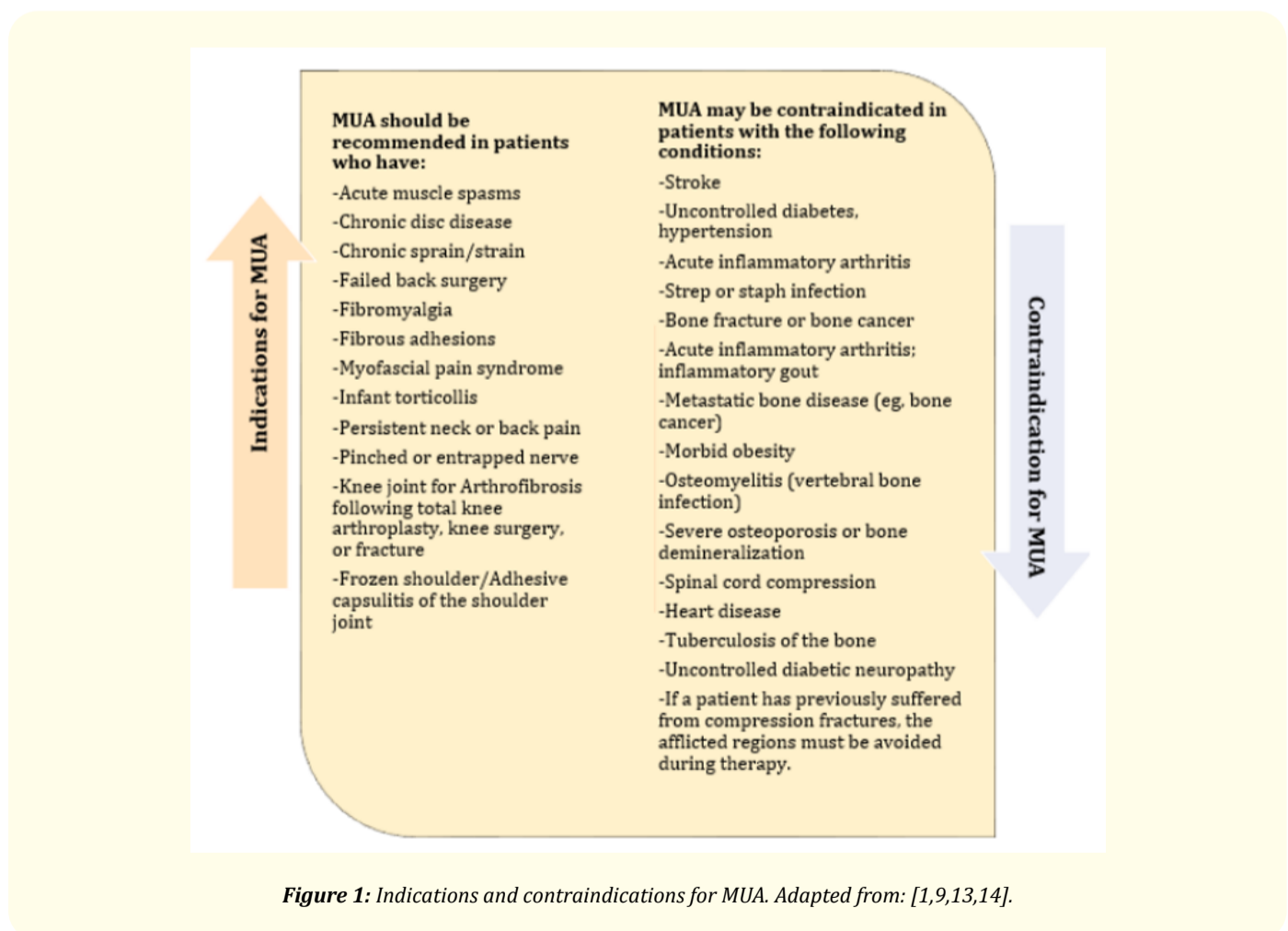
Siehl (1964) mentioned a historical (1952) research performed on a cohort of 100 patients who received SMT under local anesthesia [4]. Historical evidence also suggests that MUA (deep sedation), modification under combination anesthesia, and medications, such as epidurals, are used to treat skeletal diseases [5]. The currently used medication-assisted manipulation is considerably different from previously used MUA procedures. Operations and other pain management methods are preferred to early MUA procedures to avoid the consequences of general anesthesia and vigorous, lengthy, and elevated indiscriminate manipulative surgeries [3,6].

In the 1960s, most orthopedic practitioners had forsaken the use of MUA. However, in the 1990s, MUA was reintroduced and improved by certain natural health care practitioners and, to a lesser extent, osteopathic physicians. Also, renewed scrutiny in SMT and the introduction of generally safe local anesthetics for pain treatment are thought to have driven the return of MUA [3,6,7].

**Discussion**

Manipulation separates fibers and scar tissues to relieve tenderness and improve ROM. On the contrary, anesthesia reduces inflammation, twitch, and involuntary muscle guarding, which may impede therapy. The use of anesthesia enables the practitioner to break up joints and soft tissue contractures with much less coercion than needed to resolve in a resistant, anxious, and awake patient [8]. MUA is a non-invasive, prolonged, and manipulative method [9]. It is recommended for chronic and acute pain conditions, especially those involving the spine, when traditional therapies, such as manipulation and conservative procedures, fail. It is easier to detach and manipulate the joints when the patient’s defensive reflex systems are disabled while under anesthesia [10]. Typically, MUA works by breaking up scar-like tissues, possibly restoring the ROM and reducing pain [9]. This manipulation often consists of a high-velocity push and a crackling or breaking sound [10].

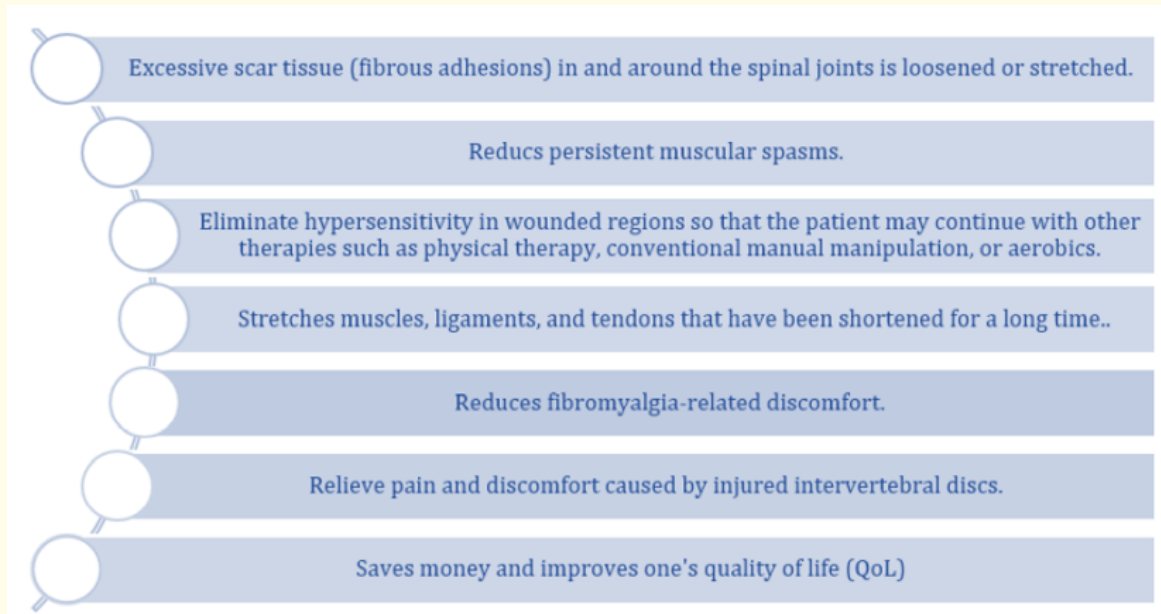
MUA is a successful therapy for common problems in a level-1 trauma center [11]. It is also helpful in treating neck, back, and joint pains, muscle spasms, and long-term pain disorders [9]. It has been used in manual therapy for about 70 years. The increasing involvement of professional health care personnel, specialized practitioners, physicians, and osteopaths in this therapy has expanded the provision of facilities and instructions to administer and approve this treatment [12]. MUA is considered for several indications and is based mainly on clinical importance [3]. Although highly effective, MUA is not recommended in certain patients. The indications and contraindications for MUA are presented in Figure 1 [1,9,13,14].



**Figure 1:** Indications and contraindications for MUA. Adapted from: [1,9,13,14].

### Benefits of MUA for patients

After an MUA procedure, the patient will notice increased mobility and decreased discomfort. The potential advantages for the patient after an MUA are listed in Figure 2.



**Figure 2:** Potential patient benefits after MUA. Adapted from: [9,15,16].

### Mechanistic basis of MUA

MUA should be considered if the pain is so severe and incapacitating that drug therapy or conventional spinal manipulation therapy is not an option. MUA is not recommended in acute trauma care. However, if required, only a single session is performed in conjunction with the patient's office-based therapy.

MUA is helpful for chronic pain when the patient's suffering is refractory to standard office-based manipulative treatments, and the condition has a considerable detrimental effect on functioning and quality of life. In contrast to pre-injury or pre-conditioning, MUA attempts to eliminate fibrous adhesions, which reduce the capacity to engage in ordinary activities [5]. In addition to manipulation, passive stretches and specific axial (atlas and axis) vertebrae or peripheral (ankle, shoulder, wrist, elbow, hand, and foot joints) [1] articular and postural kinesthetic maneuvers can be performed during the MUA procedure [1,17–19]. Several meta-analyses have evaluated MUA in persistent chronic back pain, adhesive capsulitis, stiffness after total knee arthroplasty (TKA), and other muscular and skeletal diseases [20].

### MUA for the treatment of the human spine

Typically, spinal MUA is used for patients with persistent, unspecified mechanical spinal pain who have been marginally responsive to prior conservative therapy (not attaining the desired degree of success)—being considered a failure of conservative treatment. Disk bulge or herniation, chronic recurring sprain or strain, unsuccessful back surgery, or myofascial pain disorders are possible causes of distress. Many practitioners believe that surgery is helpful for these patients [21].

Kohlbeck, *et al.* (2005) conducted a non-randomized comparison study involving 68 individuals with persistent low back pain. Following a 4- to 6-week SMT, 42 patients were given MUA as a supplementary, and 26 remained on SMT. At 3 months, the MUA arm was superior to the SMT arm in low back pain and impairment markers (4.4 points; 95% CI, -2.2 to 11.0). After 1 year, the distinction became less pronounced (0.3 points; 95% CI, -8.6 to 9.2). The MUA arm had a higher probability of a 10-point increase in symptoms and disability after 3 months [21].

Peterson, *et al.* (2014) conducted a prospective cohort study involving 30 patients with neuropathic pain (low back pain, 17; neck pain, 13). The patients received a single MUA treatment, with 2 and 3 weeks of follow-up. The primary endpoint was the Patient's Global Impression of Change. About 52% of the patients recovered (significantly better) in 2 weeks compared to 45.5% of those who improved in 4 weeks. Pain Numeric Rating System scores were reduced significantly at 4 weeks ( $P = 0.01$ ), from an average baseline score of 4.0 to 3.5 two weeks after MUA ( $P = 0.01$ ). The Bournemouth Questionnaire score increased from 24.17 to 20.38 ( $P = 0.008$ ) after 2 weeks and to 19.45 ( $P = 0.001$ ) after 4 weeks [22].

### MUA for treatment of adhesive capsulitis (frozen shoulder)

Frozen shoulder (FS) causes shoulder discomfort and impairment. It affects 2% to 4% of the world's population and is significantly more common in women than men. Most commonly involving physiotherapy and steroid infiltrations, conservative therapy is deemed suitable. However, despite conservative treatment, approximately 50% of patients experience lingering discomfort, and up to 60% indicate substantial loss of mobility. If conservative treatment fails, MUA is a well-established intervention for FS [16]. In addition, according to peer-reviewed published literature, MUA is an accepted therapy for refractory cases of adhesive capsulitis [23].

Theodorides, *et al.* (2014) conducted a study involving 295 patients with FS. Patients were enrolled in a particular order and treated with MUA. After 28 days, a substantial improvement in the Oxford Shoulder Score and ROM (average 3.6 years, significant at  $P < 0.0001$ ) was noted. Women benefited more than men ( $P < 0.0025$ ), but subsequent adhesive capsulitis considerably decreased the effectiveness of the manipulation ( $P = 0.0001$ ) [24].

Mun and Baek (2016) conducted a prospective, randomized, controlled study involving 121 patients with FS. The findings indicated that patients ( $n = 60$ ) who received hydrodistension and joint manipulation under an interscalene block had higher patient satisfaction and earlier ROM restoration than those ( $n = 61$ ) who received intraarticular steroids at 6 weeks. The pain score was significantly lower after 12 weeks, and the continuous score was higher in those who received joint manipulation than in those who received steroid injections. Joint manipulation provided early pain control and improved shoulder ROM and performance than a single intraarticular steroid injection [25].

### MUA for treatment of stiffness after TKA

During a complete knee replacement, several tissues are exposed to air, which vaporizes vital lubricants. Suppose the lubricant fluids are not rapidly supplied after surgery. In that case, the afflicted muscles that typically ride over one another may create adhesions, causing discomfort and impairing the capacity to rotate the injured limb. Therefore, MUA is performed by physicians or surgeons to bend the knee to break down the scar tissue after TKA to alleviate stiffness and inadequate ROM [26,27].

Ghani, *et al.* (2012) conducted a comprehensive evaluation of 25 published articles involving 798 patients with arthrofibrosis following TKA. Patients who received MUA had a more considerable improvement in the ROM ( $38.4^\circ$ ) than patients who received arthroscopic release ( $36.2^\circ$ ) [28].

Pivec, *et al.* (2013) comprehensively evaluated 14 publications ( $n = 913$ ) assessing changes in the ROM arc after MUA following TKA. Compared to preoperative ROM, the increase in ROM arc at 1-, 5-, and 10-year follow-up was  $30^\circ$ ,  $33^\circ$ , and  $33^\circ$ , respectively. The results

indicate that the early gains are retained for a long time and that patients can progressively improve further at mid-term follow-up in certain situations [29].

Gu, *et al.* (2018) systematically analyzed 26 articles (n = 1569). Of the 26 articles, 22 were on ROM after MUA (n = 1488), and 4 were on ROM after repeat MUA (n = 8). Except for 2 investigations, the trials indicated pre-MUA movement of < 90°, but the mean ROM at the last follow-up surpassed 90°. In this study, the average pre-manipulation ROM was 80°, and the average post-manipulation ROM was 100.6°, indicating an improvement in the ROM following MUA therapy. MUA improved the ROM in most patients, with the highest gains noted in individuals receiving treatment within 12 weeks of surgery [30].

**Manipulation of various joints under anesthesia**

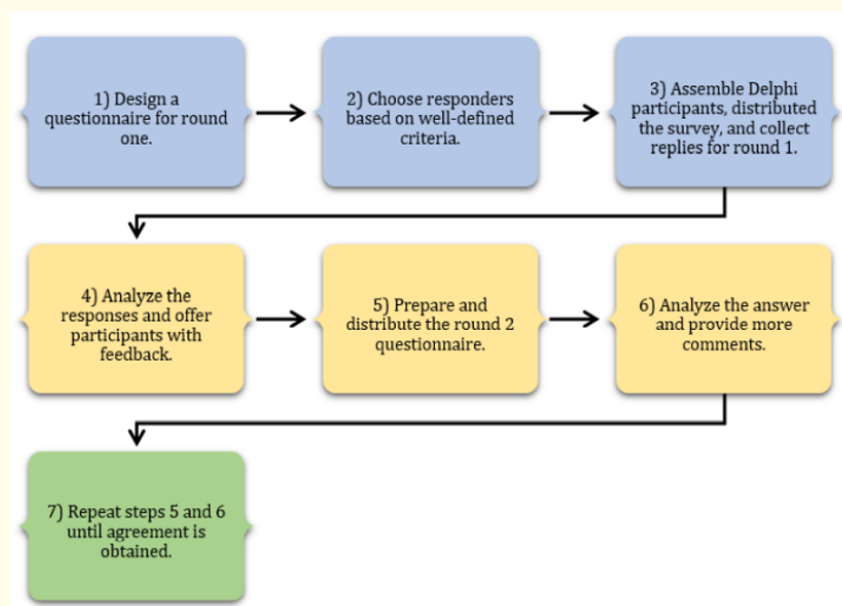
Medical literature on the use of MUA for treating pain involving multiple joints, such as the hip, ankle, toe, elbow, and wrist, is limited. The lack of data restricts the conclusion about MUA’s therapeutic value, safety, and effectiveness for alleviating pain in multiple joints [23].

Selecting patients who may benefit the most from MUA is critical to the effectiveness of treatment, although this aspect is not adequately assessed in studies [31]. According to Werner, *et al.* (2015), patients younger than 50 years had a six-fold higher possibility of necessitating modification than older individuals [32].

MUA has a success rate of 80% – 90% [13,17]. However, it is also associated with severe adverse effects, such as allergy, pulmonary and cardiac failure, vertebrobasilar stroke, degenerative disk disease, and the development of cauda equina syndrome, paralysis, coma, and death [33,34]. Fox and Poss (1981) found that manipulation caused hemarthrosis in 3 patients and wound separation in one patient. In addition, death occurred within 24 h after manipulation from a pulmonary embolism caused by deep vein thrombosis in the manipulated leg calf [35].

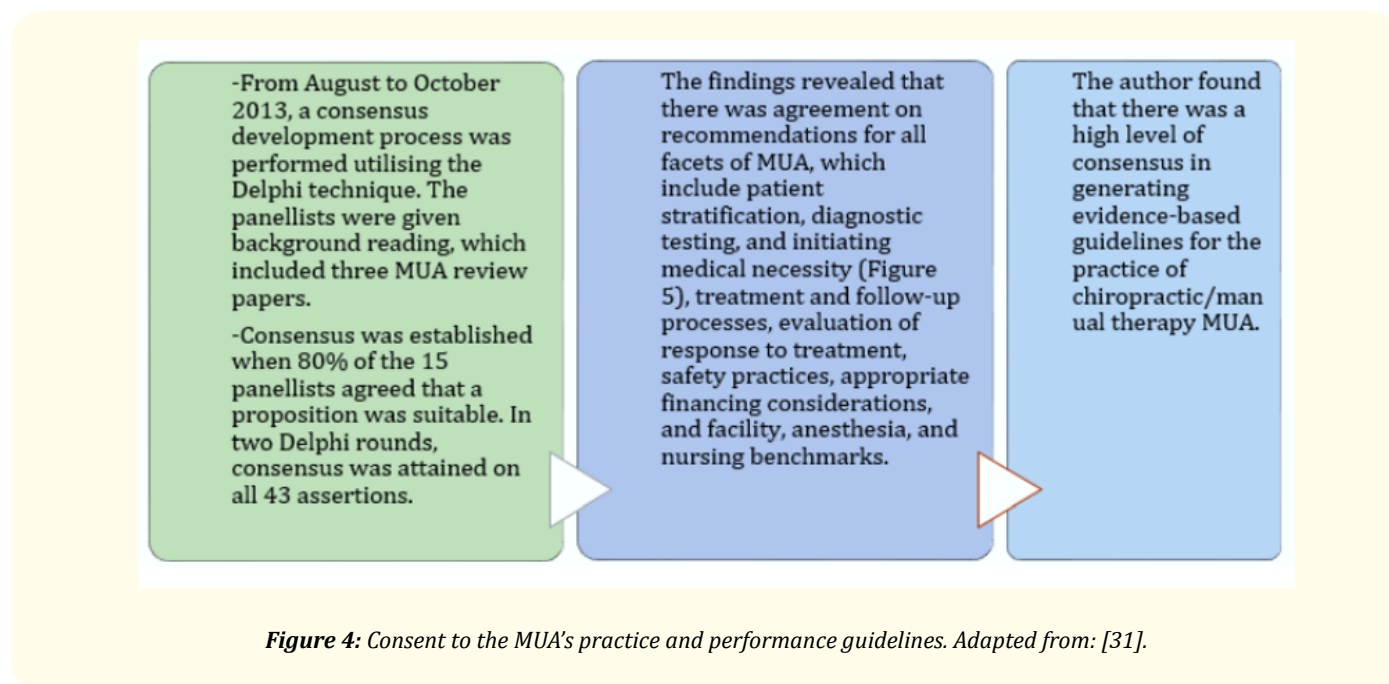
**Delphi process (method)**

The Delphi approach helps gather the most reliable consensus among specialists. It is attempted by a series of questions interleaved with controlled feedback, including group statistical responses. The Delphi method is a consensus-building tool in which the panelists are anonymous. Thus, it allows panel members to modify their thoughts based on arguments offered by other panelists without openly acknowledging them. These benefits improve consensus dependability [36]. The technique is broken down into 6 phases, listed in Figure 3 [37,38].



**Figure 3:** Flow chart representing the Delphi technique to gather consensus. Adapted from: [37,38].

Gordon, *et al.* (2014) provided evidence-based and consensus-based recommendations on SMT to overcome the gaps in research on patient stratification and treatment regimens. The consensus is detailed in Figure 4.



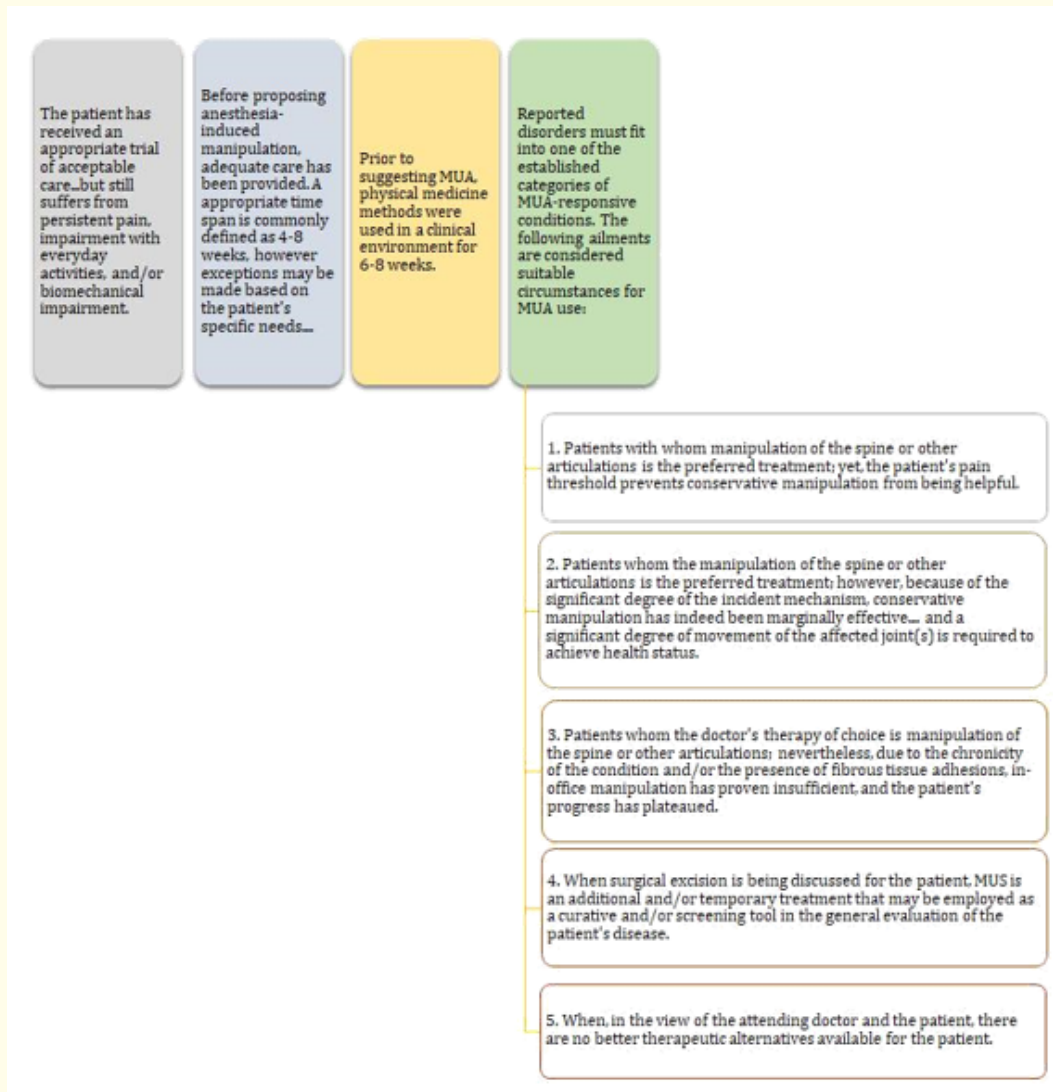
**Figure 4:** Consent to the MUA's practice and performance guidelines. Adapted from: [31].

### MUA guidelines

It is important to find training programs and clinical results that are an excellent approach to incorporating MUA procedures into acceptable hospital and outpatient surgery environments worldwide. To achieve this, research institutions and organizations worldwide have devised demanding criteria and guidelines for MUA practices that are secure and reliable [39].

The National Academy of MUA Physicians, the very first national organization, was founded in 1995 to establish federal standards and procedures for MUA operations. Also, the multidisciplinary European MUA community recently launched the International MUA Academy of Physicians, which provides a framework for the propagation of a legit and proactive database of theories and models and hypothetical scientific advancement in the development of MUA for healthcare providers treating patients with complications. These organizations have issued effective and consistent MUA guidelines and procedures by expanding evidence-based guidelines for MUA's practical application and practice [39].

In 2014, The American Association of MUA Specialists issued consensus-based recommendations for MUA practice and implementation. The following topics were covered: patient selection, medical need evaluation, repetition, and follow-up processes, MUA efficacy measurements, complete post-MUA counseling, and safety standards. The guidelines called for 3 days of therapy in a row, anchored on the theory that serial operations allow modest but effective recovery with much more biomechanical involvement (Figure 5). The recommendations also advised 8 weeks of non-anesthetic follow-up therapy consisting of all fibrosis loosening and manipulation procedures applied during the MUA surgery to help avoid re-adhesion [31,40].



**Figure 5:** Patient selection criteria for MUA. Adapted from: [31,40].

These organizations provide additional training and national and worldwide conventions to the professional community practicing MUA to implement the purpose and intent of the operation [31].

**MUA procedure for the spine**

The spine and lower limbs are mobilized after sedation by mobilization, stretching, and traction treatments. Straight-leg lifts of the gluteal and hamstring muscles, hip capsule stretching and mobilization, lumbosacral manipulation, and stretching of the lateral abdominal and paraspinal muscles are applied [40].

Manual SMT is performed in a spinous procedure, followed by stretching and traction therapy, using a high-velocity, small-amplitude pressure while the upper body and lower limbs are immobilized. SMT can also treat neck or back pain associated with the thoracolumbar region. The MUA procedure generally takes about 20 minutes, and the patient is discharged after recovering from the anesthetic effect [40].

The literature on SMT’s effectiveness under anesthesia for pain in the absence of vertebral fracture, total displacement, or acute traumatic partial displacement (subluxation) is lacking [41].

**MUA procedure for the shoulder**

The patient is placed in a recumbent position under general anesthesia, with the head pressed on a head cushion. The stretcher pole is withdrawn from the afflicted side of the individual and is being handled on a trolley. The surgeon stands at the head of the table, one hand supporting the scapula in the resting state. The surgeon places the second hand on the patient’s axilla so that the operator’s wrist rests against the inside of the patient’s arm. Once the patient’s free limit of abduction is reached, the patient is mechanically retracted while the scapula is tied down in the anatomic posture. At no point should the scapula move. The inferior capsule will rupture as a result of this technique. The shoulder is then firmly adducted, pushing the afflicted elbow in front of the individual’s chin, causing the posterior capsule to split. Finally, violent external and internal rotation is introduced, although caution is advised to avoid a spiral fracture during these last rotation procedures [42].

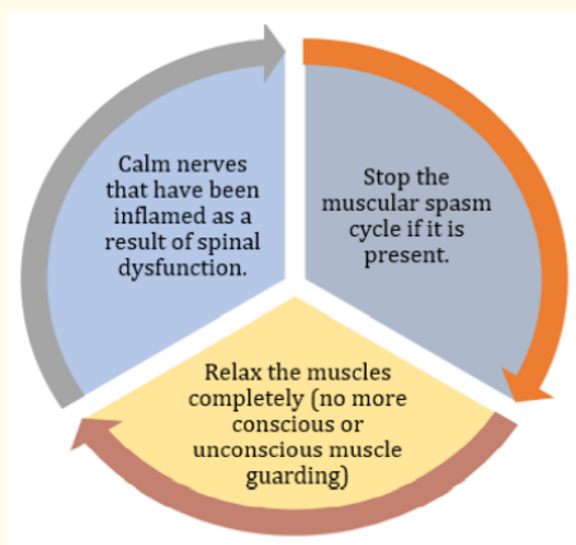
**Health care professionals for MUA**

MUA is a strenuous physical therapy technique. It is a multidisciplinary technique involving an anesthesiologist, a lead MUA specialist, an orthopedic surgeon, an osteopathic clinician who performs the manipulation, a co-attending doctor who is a first associate and accredited in MUA, and nurses and other assistants who may assist throughout the process. Interaction and cooperation among team members are critical success factors for MUA.

Because the patient is sedated, the physician must ensure that the patient does not fall off the treatment surface [7,31].

**Anesthesia applications in MUA**

Several criteria, including the specific disease and the seriousness of the situation (e.g., pain), are considered to determine the type of anesthesia. The anesthesiologist may suggest a particular medicine or combination of medications to aid patient recovery before and after treatment [9]. The anesthetic agent must be administered according to the treating institution’s guidelines [43]. Monitored anesthesia care is employed, with parenteral Diprivan (propofol) or Versed (midazolam) being the most common medications [7,31]. The role of anesthesia in the MUA procedure is detailed in Figure 6 [15].



**Figure 6:** Role of anesthesia during the MUA procedure. Adapted from: [15].



**MUA reimbursement policy**

MUA is a recognized procedure covered by most insurance policies. A single MUA session can cost \$3000.00–\$6,000.00, including with most expenses for the anesthetic agent, surgical center fees, and radiologic procedures. MUA reimbursement policies differ widely across countries [7]. However, payers have challenges paying toward procedures performed under MUA [31].

**MUA sessions for patient recovery**

MUA is provided in a single treatment session for indications—such as adhesive capsulitis, post-traumatic or postoperative arthrofibrosis of the knee, displaced fracture (e.g., vertebral and long bones), acute and traumatic dislocation (e.g., vertebral and perched cervical facets), and chronic contracture of the upper or lower extremity joint (e.g., fixed contracture from a neuromuscular condition) [23]. Additional intervention procedures involving a previously treated joint must be approved by a physician [23]. In addition, repeat therapy sessions violate the generally accepted medical practice norms and therefore are not medically necessary [23].

The anesthesiologist is responsible for administering the anesthetic agent before MUA. The manual therapist must have significant training and be licensed to deliver SMT without anesthesia. MUA accreditation should be obtained through ongoing accredited training or continuing education courses. Certification usually entails 8 to 12 h of classroom teaching, an equivalent amount of practical instruction, and several procedures proctored by an expert MUA therapist. Qualifications for MUA certification differ across states [7].

MUA is considered a medical subspecialty (i.e., it is not available in every clinical office) [44].

**Note** •The National MUA Academy of Physicians and the International Academy of MUA Physicians accept standards and protocols for creating genuine certification training programs, and qualified academic institutions offering postgraduate certification in MUA adhere to them [12].

Particular MUA distinctions used by clinicians practicing MUA are detailed in Figure 7.

MUA may be used with fluoroscopically guided intra-articular injections of corticosteroid drugs to decrease inflammation in a less common approach. This is known as manipulation under joint anesthesia/analgesia (MUJA).

Manipulation under epidural anesthesia (MUEA) involves the use of an epidural, segmental anesthetic, sometimes in conjunction with epidural steroid injections, followed by spinal manipulation treatment.

-Manipulation may be used with cortisone injections into paraspinal tissues and prolotherapy injections in some regimens.  
-Other types of anesthetic manipulation include spinal MUA with other joint manipulation and total body joint manipulation [23].

**Figure 7:** MUA distinctions to be used by physicians.

### Efficacy of MUA compared with standard physical therapy and “fringe” practices

MUA has been used for >70 years and is economical and more effective than invasive procedures such as spine surgery [9]. Despite current implant designs, superior surgical technique, and pain management that allows physiotherapy to begin hours after surgery, MUA is required in 1.3% – 13.5% of all TKA patients to recover knee ROM [45].

Evans, *et al.* (2013) studied the effects of MUA after severe knee injuries sustained in the war. The study compared MUA with open arthrolysis in the treatment of combat-related arthrofibrosis. MUA was more successful than open arthrolysis, with a lower risk of complications.

A 106° improvement was noticed following manipulation [46]. Robert Menser, an orthopedic physician, compared the outcomes of MUA with those of laminectomy in patients with lumbar intervertebral disk issues. He found that 83% of patients who received MUA had a good result compared with about 50% of patients who received surgery [2].

### MUA's future

Although MUA is widely documented, future studies must assess the advantages of extra patellofemoral joint manipulation or anti-inflammatory medicines during the procedure. In addition, repeat MUA operations require special care, and efficient post-MUA rehabilitation strategies should be developed based on the findings of randomized clinical studies [45].

### Conclusion

MUA is a process of mobilization, stretching, and traction operations performed with the patient under sedation. It is an acknowledged treatment approach for conditions, such as adhesive capsulitis, broken bones, knee arthrofibrosis, displacement, and constriction. Typically, only a single MUA session is required for specific problems—most commonly performed unilaterally and involving a single joint. MUA is an established and respectable procedure (not an exploratory or experimental technique) worthy of insurance coverage and consideration by physicians and patients.

### Conflict of Interest Statement

The authors declare that this paper was written without any commercial or financial relationship that could be construed as a potential conflict of interest.

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