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ORIGINAL ARTICLE • ELBOW - ANESTHESIA

Manipulation under anesthesia for the postsurgical stiff elbow: a case series and review of literature

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Abstract

Introduction Elbow joint stiffness is a common complication following elbow trauma or surgery. Current practices include first-line treatment with physiotherapy and various types of splints. In cases where early postoperative loss of elbow motion interferes with activities of daily living, manipulation under anesthesia (MUA) is considered a viable treatment option, but there is currently only limited data on the results of this procedure and its complications.

Materials and methods This retrospective study was comprised of 12 consecutive patients who underwent MUA for the treatment of postsurgical elbow stiffness in one institution between 2010 and 2017. Their pre- and post-manipulation range of motion and their functional scores were assessed.

Results MUA was performed at a mean of 52 days (range 39–91 days) following the last surgical intervention, and the patients were followed for a mean of 3 years (range 0.75–7 years). The average flexion–extension arc of motion improved by 53.8°, and the average rotation arc improved by 57°. The average Mayo Elbow Performance Score was 73 (range 0–100) at the latest follow-up. Two patients eventually underwent an open elbow contracture release due to poor post-manipulation results. There were no post-MUA complications.

Conclusions MUA of a postoperative stiff elbow can improve both flexion–extension and rotatory arc of motion in cases of early evolving postoperative stiffness and should be part of the armamentarium for the treatment of this often debilitating condition.

Keywords Manipulation under anesthesia · Stiff elbow · Range of motion · Contracture release · Case series

Introduction

Elbow joint stiffness is a common and disabling complication following elbow trauma and/or surgery [1, 2]. Normal elbow motion has been described as a flexion–extension arc of 0–140 degrees, and a pronation–supination arc of 85–85 of degrees [3]. Elbow stiffness is defined as the loss of the normal range of motion (ROM), such that the decrease in the flexion–extension arc or in the rotational arc to less than 100 degrees results in marked impairment in the ability to perform activities of daily living [4]. The etiologies for elbow stiffness can vary, and they include soft-tissue contractures, heterotopic ossification, extra- or intra-articular fracture malunion or nonunion, and loss of articular cartilage [2].

Treatment of elbow stiffness includes conservative measures, such as physiotherapy, serial bracing, splinting, and elbow manipulation under anesthesia (MUA). Refractory cases may require operative treatment, such as arthroscopic or open contracture release [1]. MUA is currently mentioned as a treatment option for early evolving joint stiffness [1]. Although it is considered an important tool in the therapeutic armamentarium of the orthopedic surgeon, only scarce data on its outcome are available in the literature [5–8].

The senior author has been treating early evolving postoperative elbow stiffness by means of MUA for the last 8 years. The purpose of this study is to report the indications, methods, and outcomes of a cohort of patients treated with this technique during that time frame.

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Materials and methods

After the acquisition of institutional review board approval, we performed a retrospective study on all the patients who underwent MUA for the treatment of early postoperative elbow stiffness in our institution between 2010 and 2017. Patients with disabling early postoperative elbow stiffness despite having undergone intensive physiotherapy and splinting were offered MUA as the next treatment option. Their medical charts were reviewed, and their demographics and functional data were retrieved, as were their Mayo Elbow Performance Scores (MEPS [9]). Patients with less than 6-month follow-up were excluded. Elbow ROM of the sedated patients was measured with a goniometer at the operating theater just before the MUA, and at the final follow-up visit in the outpatient clinic. An updated performance questionnaire (quick DASH [10]) was filled in via telephone interviews.

MUA was performed in the operating theater with the patient under sedation (Propofol, 1–2 mg/kg). When technically feasible, an additional continuous supraclavicular nerve block was performed and retained for 3 days to allow for early painless physiotherapy. During the MUA, a constant load was applied in one direction at a time (extension/flexion/pronation/supination), accompanied by gently and gradually increasing the elbow's ROM (Fig. 1a, b). When full ROM was not achieved with relatively gentle force, no attempts were made to increase the applied force and the maximal range that has been achieved was measured by a goniometer and recorded.

Dynamic fluoroscopic motion images, recording the maximal ROM that has been achieved, were taken during the procedure (Fig. 1c, d) and were shown to the patients the following day, in an attempt to increase their motivation.

At the end of the MUA, the manipulated elbow was placed in a plaster splint in an opposing direction to the greatest pre-manipulation range deficit, usually in extension, for 2 days (Fig. 1e). The patients remained in the hospital for 3 additional days to allow early physiotherapy and pain management. At discharge, the patients were instructed to continue daily physiotherapy and the use of a nighttime extension splint.

Results

A total of 14 patients with early evolving postoperative elbow stiffness who were treated with MUA during the study period were identified. Two patients were excluded from the study due to lack of follow-up data, leaving a total of 12 patients (9 males) who fulfilled the study inclusion criteria. The average age of the participants was 36.6 years (range 12–75 years), and the dominant side was involved in 7 out of 12 cases (58%). The etiology that led to the primary surgery was trauma in 9 cases and sarcoidosis, loose bodies, and radial head dysplasia in the remaining 3 cases.

MUA was performed at an average of 52.3 days (range 39–91 days) following the index procedure. Full ROM was achieved in 9 cases. Additional concomitant open procedures, unrelated to the stiffness and/or MUA, were performed in 3 cases and included 2 cases of hardware removal from the olecranon, and 1 conversion of an olecranon plate into tension band wiring due to wound complication. A continuous supraclavicular nerve block was placed when feasible and maintained for 3 days in 7 (58%) out of the 12 patients.

The average post-MUA follow-up was 35 months (range 9–86 months). The average flexion–extension arc increased from 33.3° pre-manipulation to 87.1° at the final follow-up. The average pronation–supination arc increased from 120.5° pre-manipulation to 139°.

When patients who had normal rotational arc prior to and following the MUA were excluded, it increased from 73° pre-MUA to 130° at the final follow-up. The average MEPS at the final follow-up was 73 (range 25–100). The patients' data and results are summarized in Table 1.

There were no complications following the MUAs. Two patients eventually had an open elbow contracture release due to poor post-manipulation ROM and function. Updated performance (quick DASH) questionnaires were filled in by means of telephone interviews in all but one noncompliant patient. The average final DASH score was 34 (range 0–81).

Discussion

The current study presents our experience with MUA for the treatment of early evolving postoperative elbow stiffness. Although this is a widely accepted and recommended treatment option [2], there are only few reports on this procedure and its outcome in the literature (Table 2). Most of the patients who were treated with MUA in our series were post-traumatic (9/12, 75%), but patients with stiff elbows due to other pathologies have also been included.

MUA can apparently be suitable at any age. Indeed, most of our patients (10 out of 12) were young adults (20–40 years), whereas one patient was a 12-year-old teenager who underwent MUA following radial head excision due to radial head dysplasia, and another patient was 75-year-old who underwent MUA following ORIF of the olecranon.

The improvement that has been achieved in the rotatory arc of motion following the MUA is worth mentioning. The

Fig. 1 A 55-year-old female undergoing MUA. The flexion (**a**) and extension (**b**) range of motion is gradually increased by placing a gentle force on the forearm. The final range of motion is documented using fluoroscopy imaging (**c**, **d**), and the elbow is placed in a splint (**e**) until physiotherapy is initiated the next day

arc increased significantly from 73° pre-manipulation to 130° post-MUA in 5 patients who presented with considerable limitation in rotation (patients no. 3, 4, 6, 8, and 10 in Table 1). We could not find any published data regarding the rotatory ROM and its improvement following MUA. The findings of the current study suggest that MUA could be a viable treatment option for the treatment of rotatory stiffness as well.

Up until recently, there were no clear recommendations or guidelines regarding the best timing for MUA of stiff elbows. In our practice, the time frame for preforming MUA was set between 6 weeks and 3 months, leaving sufficient time to appreciate lack of progress in ROM while minimizing the potential risk of complications following the MUA such as iatrogenic fractures, nerve damage, and skin breakdown. In their recent series of 45 patients with post-traumatic elbow stiffness treated with MUA, Spitler et al. showed that MUA is only effective when performed within 3 months of the original trauma or surgery. In their study, patients were divided into early (within 91 days) and late (after 91 days) manipulation groups. Only the early manipulation group showed statistically significant improvement in total flexion/extension arc at the final follow-up (38.3° vs. 3.1°; $p < 0.001$) [8].

The post-MUA treatment protocol that we propose differs somewhat from that described by Araghi et al. [5]. For

Table 1 Patient data and results

Patient number	Age	Sex	Manipulated elbow (* dominant)	Nerve block	Pathology leading to elbow surgery	Last surgery	Days from last surgery to MUA	Another procedure during MUA	Range of motion					MEPS	Quick DASH
									Pre-flx–ext (arc)	Pre-pro–sup (arc)	Range during MUA	Last flx–ext (arc)	Last pro–sup (arc)		
1	37	M	Lt	+	Sarcoidosis	Arthroscopic synovectomy + open ulnar neurolysis	39	NA	30–100 (70)	NA	FROM	10–110 (100)	NA	45	11
2	33	M	Lt	+	Radial head Fx, ORIF	Open contracture release	41	NA	30–40 (10)	85–75 (160)	FROM	70–100 (30)	30–30 (60)	25	81
3	35	M	Rt*	+	Intra-articular loose bodies—most probably due to recurrent trauma	Open contracture release	39	NA	10–20 (10)	85–50 (135)	FROM	0–100 (100)	85–85 (170)	85	66
4	27	F	Lt	–	Montegia Fx + Coronoid Fx + Radial head Fx	ORIF olecranon + coronoid	91	Hardware removal + revision of scar (dehiscence)	30–80 (50)	20–0 (20)	Pro 60	10–125 (115)	30–60 (90)	75	36
5	19	F	Rt*	–	Distal humerus Fx, ORIF	Open contracture release + hardware removal	40	NA	20–80 (50)	85–85 (170)	FROM	0–120 (120)	85–85 (170)		
6	35	F	Rt*	–	Distal humerus Fx	ORIF distal humerus	58	Wound debridement, revision ORIF olecranon	70–100 (30)	20–20 (40)	ext −10	0–115 (115)	85–85 (170)	100	11
7	40	M	Lt*	–	Radial head Fx	Open contracture release	54	NA	45–90 (45)	85–85 (170)	FROM	45–130 (85)	85–85 (170)	70	55
8	35	M	Rt*	+	Distal humerus Fx proximal ulna Fx, loose bodies	Radial head excision + open contracture release	51	NA	30–70 (40)	0–85 (85)	FROM	30–100 (70)	10–80 (90)	80	16
9	54	M	Rt*	–	Olecranon Fx, ORIF	Open contracture release + hardware removal	49	NA	45–80 (35)	85–85 (170)	FROM	30–120 (90)	85–85 (170)	60	55

Table 1 (continued)

Patient number	Age	Sex	Manipulated elbow (* dominant)	Nerve block	Pathology leading to elbow surgery	Last surgery	Days from last surgery to MUA	Another procedure during MUA	Range of motion					MEPS	Quick DASH
									Pre-flx–ext (arc)	Pre-pro–sup (arc)	Range during MUA	Last flx–ext (arc)	Last pro–sup (arc)		
10	12	M	Rt*	+	Radial dysplasia	Radial head excision + achilles interposition arthroplasty + open contracture release	39	NA	20–40 (20)	85–0 (85)	FROM	15–130 (125)	85–70 (145)	100	0
11	37	M	Lt	+	Open wound infection, multiple debridements, skin graft	MCL reconstruction + skin graft	73	I&D of elbow, hardware removal	80–90 (10)	NA	ext −20	80–100 (20)	85–85 (170)	65	23
12	75	M	Lt	+	Olecranon Fx	ORIF olecranon	53	NA	70–90 (20)	85–85 (170)	FROM	50–130 (80)	85–85 (170)	95	18

Fx fracture, *HO* heterotopic ossification, *I&D* irrigation and debridement, *MCL* medial collateral ligament, *ORIF* open reduction internal fixation, *FROM* full range of motion, *pro* pronation, *sup* supination, *flx* flexion, *ext* extension

Table 2 Publications on the use and outcome of the manipulation under anesthesia technique

Authors	Cases, *N*	Specific indication	Age, range (avg)	Results, *N* (%)			Arc of motion change	Complications and later procedures
				Gained motion	No change	Lost motion		
Garland et al. [7]	13	Heterotopic ossification	17–35 (24)	5 (38%)	5 (38%)	3 (23%)	19° Excluding 4 patients that turned out ankylosed: 38°	6 Patients had 2 manipulations
Duke et al. [6]	11	Following elbow trauma and surgery	15-48 (28)	6 (55%)	3 (27%)	2 (18%)	30°	2 Cases of transient ulnar paresthesia
Araghi et al. [5]	44	Following surgical release	15-59 (35)	28 (64%)	15 (34%)	1 (2%)	38°	4 Patients had 2 manipulations 3 Cases of ulnar paresthesia, 1 requiring anterior ulnar nerve transposition
Spitler et al. [8]	45	Post-traumatic	17-78 (45)	25 (56%)	11 (24%)	9 (20%)	26°	12 Patients had subsequent procedures (27%) 1 Case of tearing of skin graft
Current study (2019)	12	Postsurgical	12-75 (37)	9 (75%)	3 (25%)	0	54°	2 Patients had subsequent procedures (17%)

example, we did not inject Marcaine and methyl prednisolone to the manipulated elbows. In addition, when technically feasible, we applied a continuous supraclavicular nerve block to our patients, for 3 days, in order to allow early painless physiotherapy while avoiding pain-related psychological stress. Furthermore, we recommended an immediate physiotherapy regimen composed of active and active-assisted open-chain ROM drills, combined with nighttime extension splints.

The only MUA-related complications reported by others were ulnar nerve neuropraxia, which usually resolved spontaneously [5, 6], and tearing of a skin graft that healed spontaneously with local wound care [8]. The most dreaded possible complication of MUA is an iatrogenic fracture, which can be avoided by performing the MUA gently, patiently, and under fluoroscopic control. There were no complications among our study participants.

The outcome of MUA in our cohort of patients is somewhat better than that reported in the literature, both in the percentage of patients who improved and in the extent of improvement following the MUA. There are several possible explanations for that: (1) the small number of patients in the current series; (2) differences in the post-MUA protocols, especially the use of continuous supraclavicular nerve block for 3 days combined with daily physiotherapy; (3) early postoperative MUA (within 90 days from the index procedure).

The limitations of the current study are mostly inherent to its retrospective nature: (1) The decision to preform MUA was made by the senior author (YR) without adhering to specific guidelines; (2) the small sample size and the heterogeneity of the original pathologies temper with the generalizability of the results; (3) while MUA was found to be effective, it was not compared to other possibly effective conservative treatment options such as progressive splinting [11].

In conclusion, our experience with MUA on 12 consecutive patients indicates that it is a viable and safe treatment option in cases of early evolving postoperative elbow stiffness at almost any age. Our results showed the additive value of the procedure on motion deficits in both flexion–extension and forearm rotation. Further data are needed to refine the best inclusion criteria, timing, and best indications for MUA as well as the ideal post-manipulation therapy protocols, and the possible additive value of a CPM device following the procedure.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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