

# Comparison of Conservative and Surgical Management of Displaced Midshaft Clavicular Fractures

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## ABSTRACT

**Background:** The fracture of clavicle is very common as it is a subcutaneous bone. Midshaft fractures have traditionally been treated conservatively. The aim of this study is to compare the functional outcomes of conservatively and surgically treated groups. **Methods:** 36 patients are included in this study and patients were randomly divided into two groups of 18 each taken for conservative management and surgical management. Constant and Murley scoring system was used to assess functional outcome of patients. **Results:** It was found out that surgically treated patients had significantly better functional outcome at 6<sup>th</sup> week, 3<sup>rd</sup> month, 6<sup>th</sup> month and at 1 year respectively as compared to conservatively treated group. **Conclusion:** According to this study, surgery can be recommended over conservative treatment in patients with displaced mid shaft clavicular fractures.

**Keywords:** Midshaft clavicle fracture, surgical management, TENS nailing, clavicle plating, conservative management, clavicle brace with sling application, Constant and Murley Score, functional outcome.

## INTRODUCTION

Clavicle fractures account for approximately 2.6% of all fractures and for 44% to 66% of fractures around the shoulder. Middle third fractures account for 80% of all clavicle fractures, whereas fractures of the lateral and medial third of the clavicle account for 15% and 5%, respectively. The clavicle is an S-shaped bone that acts as a strut between the sternum and the gleno-humeral joint.

The mid-clavicular region of clavicle is a common site which accounts for most fractures occurring in this region. After conservative treatment, particularly in displaced fractures with some amount of shortening, will have some degree of disability at shoulder girdle. Operative treatment results in anatomical reduction, quick pain relief, early mobilization and good functional outcome. Therefore there is increasing trend to operate all displaced clavicle fracture. More and more surgeons now prefer to do surgery as the results of non-operative management are seen inferior both functionally and clinically. But surgical methods for treating fracture clavicle are not complication free; there can be skin infection, keloid formation, wound dehiscence, delayed union, non-union,

iatrogenic great vessel damage or brachial plexus injury.

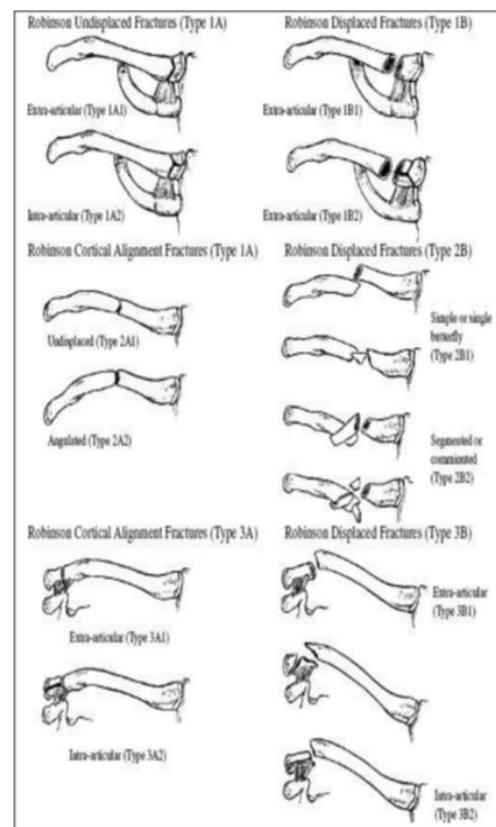


Figure 1: Robinsons classification of Clavicle fracture

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Different techniques, such as intramedullary K-wires fixation, Steinmann pin fixation, TENS fixation or plate fixation, are available for surgical treatment of midshaft clavicular fractures. Various plates available are reconstruction plates, dynamic compression plates, semitubular plates and locking compression plates. Of all of these, the most preferred is precontoured locking compression plate (LCP). Various braces are introduced in the conservative stream to immobilize the mid third clavicle, especially Bohlers brace, Parham support, Velpeau wrap, Taylors support, Billington yoke and Figure of eight brace. Among conservative braces, the most widely used is the commercial figure of eight brace. This study aims to evaluate functional outcome and complications in conservatively and surgically treated midshaft clavicular fractures.

#### **Aim and Objectives**

1. To compare the functional and radiological outcomes in mid shaft clavicular fractures treated conservatively and surgically as assessed by Constant and Murley score.
2. To study the incidence of post treatment complications like nonunion, delayed union, shoulder stiffness, infection, keloid formation etc.

### **MATERIALS AND METHODS**

Based on Robinson's classification (2B1) midshaft displaced clavicle fracture were segregated into two groups, of 18 each (total 36 cases) taken for conservative management and surgical management. The cases were between 18 years to 60 years. This study is a hospital based prospective randomized trail done in department of Orthopaedics, Muzaffarnagar Medical College, Muzaffarnagar for duration of 18 months.

#### **Inclusion criteria:**

1. Both males and females patients between 18 to 60yrs age.
2. Displaced middle third clavicle fractures (Robinson type 2B1)

#### **Exclusion criteria:**

1. Age < 18 years and >60years
2. Fractures of lateral and medial third of clavicle.
3. Open and comminuted fractures.
4. Undisplaced fractures.
5. Polytrauma patients.

6. Pathological fractures.
7. Medically unfit for surgery.

#### **Conservative Management**

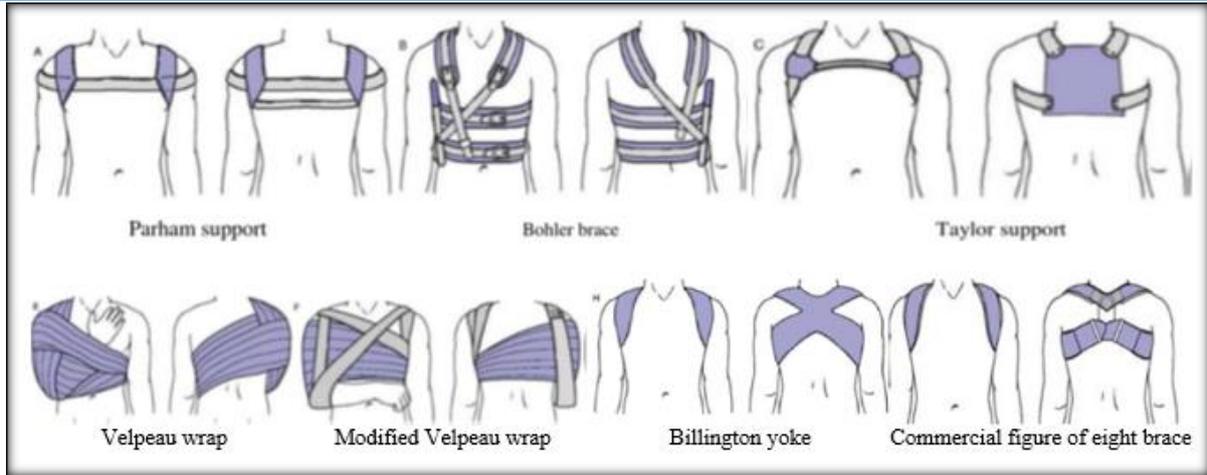
A figure of eight clavicle brace and arm pouch/sling was given to patients treated conservatively. After making the patient sit on a stool/couch, the patient was asked to sit erect with both hands kept at the waist and shoulder pulled backwards as much as possible and clavicle brace applied. To support the upper limb of same side, an arm pouch/sling was also given. The clavicle brace was used for 6 weeks, and patients were reviewed and if belt found loosened, it was adjusted every week. Numbness and distal upper limb pulses were checked, after tightening. Patients and patient attendants were also taught how to tighten the brace when required. It was advised that the brace be used all day (including bed-time). In order to keep the shoulder in the correct position during sleep, patients were also recommended to put a rolled up towel between their shoulders on the bed during the night. Radiographs were taken during immediate post bracing period, at 6<sup>th</sup> week, at 3<sup>rd</sup> month, at 6<sup>th</sup> month and at 12<sup>th</sup> month.



**Image 1: Clavicle brace and sling application**

#### **Rehabilitation protocol (for conservative group):**

- Day 1 to 6 weeks: - A clavicle brace was placed on the patient and the limb was immobilised with a sling / arm pouch. With no movement permitted at shoulder, the elbow was held at 90 degree flexion. After 4 weeks, pendulum exercises of the shoulder were started gently in the sling.
- At 6 to 8 weeks: Active to active - assisted movement was allowed in all planes.
- At 8 to 12 weeks: Isotonic and isometric exercises were prescribed to the shoulder girdle muscles.



**Figure 2: Types of Clavicle Brace**

**Case 1 (conservatively treated)**



**Surgical Management**

The main goal of surgical management in clavicle fracture is to achieve union of fracture in near normal anatomical position. It is a must to get adequate stability of the shoulder girdle. It may be done by any of these methods:-

**1. TENS fixation**

Intramedullary nailing of clavicular fractures has been done for over 50 years, with a variety of devices, including Rockwood pins, Kirschner wires, Kuntscher nails and Rush nails. Suggested advantages of intramedullary fixation include small skin incision, less periosteal stripping, and relative

stability to allow callus formation, but frequent complications such as intrathoracic migration, pin breakage, and damage to underlying structures have limited the use of this technique. A biomechanical study comparing fixation of clavicle with 3.5-mm compression plates and 3.8- or 4.5-mm intramedullary pins also showed that plated constructs were superior in resisting displacement. More recently, titanium elastic intramedullary nails have been used, with good results reported in a number of studies.

**2. Plate and screw fixation.**

Plating techniques continue to evolve. Newer precontoured plates allow more accurate fitting while maintaining strength; however, complications have been reported with 3.5-mm reconstruction plates, which allow easy contouring but too weak to maintain reduction. Currently, the most commonly used technique is superior placement of the plate but when the fracture configuration allows we prefer anteroinferior plate placement because of the safe screw trajectory and less hardware irritation. Regardless of the plate placement, meticulous attention is mandatory to preserve the periosteum and avoid injury to the subclavian vessels and lungs. Lag screw fixation should be used when possible.

**Indications:**

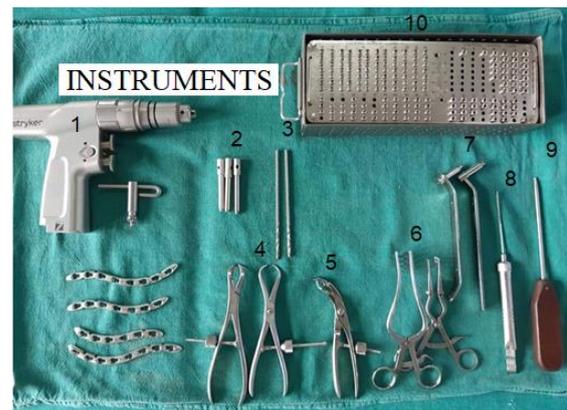
**Indications for surgical management of clavicular fractures are:**

- Severe displacement caused by comminution with resultant angulation and tenting of the skin severe enough to threaten its integrity and that fails to respond to closed reduction.
- Neurovascular injury or compromise which, after the closed reduction of the fracture, is progressive or fails to reverse.
- Open fracture.
- Multiple trauma, when patient mobility is necessary and closed methods of immobilization are impractical.
- Floating shoulder.
- Symptomatic non-union.
- Inability to tolerate closed immobilization such as in neurological problems, for example, Parkinsonism, seizure disorders.
- Cosmetic reasons.

**Technique**

- Place the patient supine with a large bump placed between the scapulae, allowing the injured shoulder girdle to fall posteriorly, which helps to restore length and increase exposure of the clavicle.
- Make an incision centered over the fracture from the sternal notch to the anterior edge of the acromion.
- Release the lateral platysma and identify the supraclavicular nerve traversing the anterior aspect of the clavicle.
- Incise the clavipectoral fascia along its attachment to the anterior clavicle and carefully elevate it inferiorly.
- Dissect first along the medial fragment, which usually has flexed up away from the vital infraclavicular structures. For acute fractures, only minimal soft-tissue dissection is needed.
- Reduce the fracture and hold it with bone clamps.

- Contour a 3.5-mm plate to fit along the superior surface of the clavicle. Usually, an eight-hole plate fits well when contoured into an S-shape as viewed on edge.
- Insert the screws from superior to inferior, taking care to avoid injury to the neurovascular structures. If an oblique fracture is present, a lag screw can be placed either through the plate or directly into the bone at roughly a 90-degree angle to the fracture line before applying plate.
- After achieving adequate hemostasis, incision is closed in layers and sterile dressing is done.



**Image 2: Instruments**

1. Battery operated drill.
2. Drill sleeve.
3. Drill bit.
4. Bone reduction/holding forceps.
5. Plate holding forceps.
6. Self retaining retractor.
7. Angle guide
8. Depth gauge.
9. Screwdriver.
10. Screw case containing screws of variable sizes.

**IMPLANTS**



**Image 3: Implants- Precontoured Locking compression Plate, Locking screw, Cortical screw**

**Rehabilitation protocol (for surgical group):**

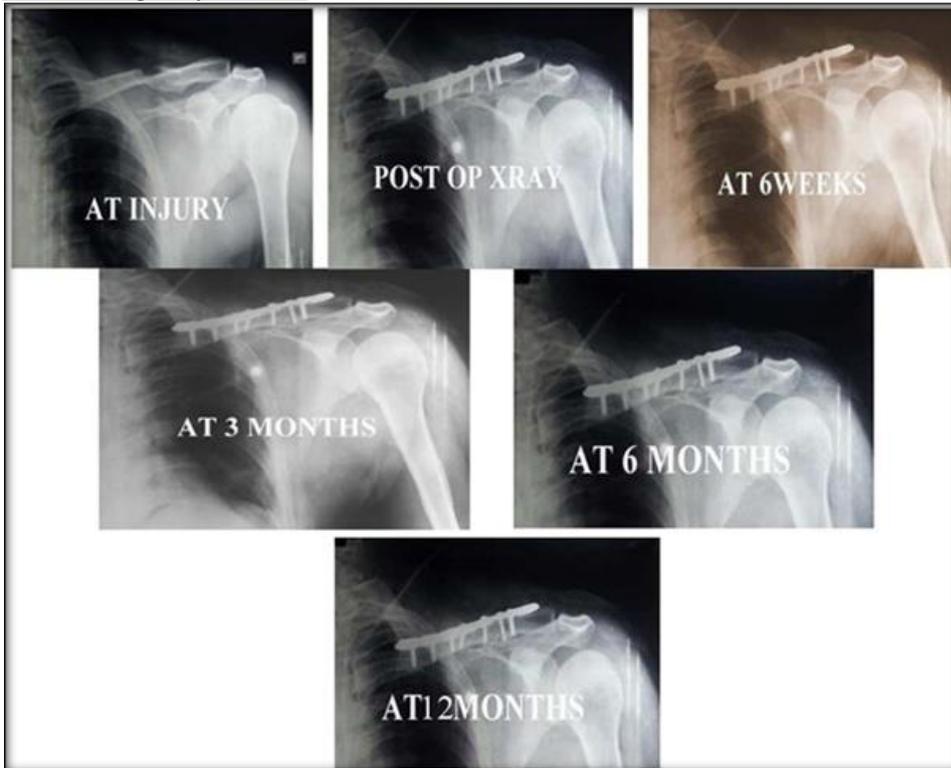
- Day 1 to Day 7: Limb was immobilized in a sling with shoulder held in adduction and internal rotation. Elbow is maintained at 90° of flexion with no movement permitted at shoulder to avoid pain & stress at suture line.
- At 2 weeks: After suture removal gentle pendulum exercises to the shoulder in the sling was allowed.

- At 4 to 6 weeks: At the end of 6 weeks gentle active movement at shoulder was allowed. Abduction was limited to 80°.
- At 6 to 8 weeks: Active to active - assisted movement in all planes was allowed.
- At 8 to 12 weeks: Isometric and isotonic exercises were prescribed to the shoulder girdle muscles.

**Follow UP:**

Regular follow-up every week for first 2weeks followed by once in the 6 weeks, 3 months, 6 months and 12 months. The functional outcomes were assessed by Constant and Murley score at follow-up period.

**Case 2 (Surgically treated)**



**Constant and Murley scoring system**

Constant and Murley scoring system is a 100 point scale consists of four variables that are used to assess the function of the shoulder, which are 1) Pain 2) Activity level 3) Range of motion 4) Muscle strength. The subjective variables are pain and ADL (sleep, work, sports) which give a total of 35 points. The objective variables are range of motion and strength which give a total of 65 points. And finally grading of Constant Shoulder Score measured by 90-100 = Excellent, 80-89 = Good, 70-79 = Fair, 0-70 = Poor

**Table 1: Subjective & objective variables of Constant and Murley scoring system**

<b>Subjective</b>	
1. Pain	15
2. Activities of Daily Living (sleep, work, sports)	20
<b>Objective</b>	
1. Range of motion	40
2. Muscle Strength	25

**Table 2: Constant and Murley scoring calculation**

	Parameters	Degree	Points
1.	Pain	None Mild Moderate Severe	15 10 5 0
2.	(i)Activities of daily Living (ADL) And  (ii)Arm Positioning	Full work Full recreation/sport Unaffected Sleep  Up to the waist Up to the xiphoid Up to the neck Up to top of the head Above the head	4 4 2  2 4 6 8 10
3.	Range of Motion		40
4.	Muscle Strength (1 point per pound of weight held in abduction by arm at 90 degrees).		25
	Total		100

**Range of Motion**

Measuring active range of motion with the patient sitting on a chair or bed, with weight even distributed between the ischial tuberosities. No rotation of the upper body took place during the examination. In the case of active motion, the patient lifts his arm to a pain free level. Number of degrees at which the pain starts determines the range of motion.

<b>(i) Forward flexion 10 points</b>	
0-30	0
31-60	2
61-90	4
91-120	6
121-150	8
151-180	10

<b>(ii) Abduction 10 points</b>	
0-30	0
31-60	2
61-90	4
91-120	6
121-150	8
151-180	10

<b>(iii) External rotation 10 points (hand is not allowed to touch the head)</b>	
Not reaching the head	0
Hand behind head with elbow forward	2
Hand behind head with elbow back	2
Hand on top of head with elbow forward	2
Hand on top of head with elbow back	2
Full elevation from on top of head	2

<b>(iv) Internal rotation 10 points</b>	
End of the thumb to lateral thigh	0
End of the thumb to buttock	2
End of the thumb to lumbosacral junction	4
End of the thumb to L3 (waist)	6
End of the thumb to T 12	8
End of the thumb to T 7(interscapular)	10

**Muscle Strength**

Strength is given a maximum of 25 points in the Constant and Murley Score. The European Society for Shoulder and Elbow Surgery measures strength according to the following method:

- A spring balance is attached distal on the forearm.
- Strength is measured with the arm in 90 degrees of elevation in the plane of the scapula (30 degrees in front of the coronal plane) and elbow straight.
- Palm of the hand facing the floor (pronation).
- The patient is asked to maintain this resisted elevation for 5seconds.
- It is repeated 3 times immediately after another.
- The average in pound (lb) is noted.
- The measurement should be pain free. If pain is involved the patient gets 0 point. If patient is unable to achieve 90<sup>0</sup> of elevation in the scapula plane the patient gets 0 point.

**RESULTS**

The present study consists of 36 patients, among which 18 patients of fresh fracture of the mid-third clavicle treated surgically and 18 patients who were treated conservatively. Patients were followed up at 6<sup>th</sup> week, at 3<sup>rd</sup> month, at 6<sup>th</sup> month and at 12<sup>th</sup> month. Results were analyzed both clinically and radiologically.

**Mode of injury:**

Out of the 36 patients that were included in the study, 26 patients (72.2%) sustained fracture as a part of a Road traffic accident and 10 patients sustained fracture due to fall from height (27.8%).

**Table 3: Mode of Injury**

Mode of Injury	No. of Middle third clavicle	%
1. Road traffic Accident	26	72.2
2. Fall from Height	10	27.8
Total	36	100

**Comparison of Constant and Murley score between surgical and conservative group**

There was a statistically significant difference in Constant and Murley score at 6 weeks, at 3 months,

at 6 months and at 12 months between surgical group and conservative group and scores were significantly higher in surgical group than conservative group.

**Table 4: Comparison of Constant and Murley score between surgical and conservative group**

Constant and Murley score	Surgical group		Conservative group		t value	p value
	Mean	SD	Mean	SD		
At time of injury	29.44	2.81	28.22	1.80	1.553	0.130
At 6 weeks	56.78	5.53	44.89	4.30	7.198	0.000
At 3 months	71.11	5.91	67.56	3.72	2.159	0.038
At 6 months	80.11	7.69	73.11	4.51	3.33	0.002
At 12 months	85.50	6.80	77.88	3.90	3.981	0.000

**Table 5: Distribution of complications in conservative and surgical group**

	Surgical Group (Total 18)		Conservative Group (Total 18)	
	Frequency	Percentage	Frequency	Percentage
No complications	13	72.22	7	38.9
<i>Adverse events :-</i>				
Wound dehiscence	1	5.56	0	0
Keloid formation	2	11.11	0	0
Shoulder stiffness	0	0	5	27.78
Superficial Skin infection	2	11.11	0	0
Delayed union	0	0	2	11.11
Non union	0	0	4	22.2
Total	18	100	18	100

**DISCUSSION**

The results of present study of patients with middle third clavicle fractures is compared with the results of standard literature. The commonly compared studies are Bostman et al study which treated 103 patients with middle third clavicle fractures, by early open reduction and internal fixation with plate and screws. Cesare Faldini et al study was also used to compare the results, where 100 patients with a clavicle mid shaft fracture were treated by figure of eight clavicle brace.

In a study conducted to analyze the results of conservative treatment by Hill et al in 1997, Nordqvist et al in 1998 and Robinson et al in 2004 found poor results following conservative treatment of displaced middle third clavicle fracture. Previously, mal-union of the clavicle (which is typical with displaced fractures) was thought to be of radiographic interest only and required no treatment. But now clavicular mal-union is regarded as a distinct clinical entity with radiographic, orthopaedic, neurologic, and cosmetic features. Nowak et al examined the late sequelae in 208 adult patients with clavicular

fractures and found that, at ten years after the injury, ninety-six patients (46%) still had symptoms despite the fact that only fifteen (7%) had a non-union. Many recent published articles document the success of open reduction and internal fixation for nonunion of displaced clavicular fractures with low complication rates. Most of these authors used plate fixation to treat these patients.

In our study we compared two accepted treatment modalities of fracture mid third clavicle.

**Complications:**

**Nonunion**

In my study, no patient had non-union among the surgical group and 4 patients (22.2%) had non-union among the conservative group.

In Bostman et al study, no surgically treated patients went for nonunion. In a study by Hill et al in non-operatively treated fracture clavicle, nonunion rate reported was 15%.

### **Delayed Union**

In my study, no patient had delayed union among the surgical group and 2 patients (11.11 %) had delayed union among the conservative group.

### **Shoulder Stiffness**

In my study, no patient had shoulder stiffness among the surgical group and 5 patients (27.78 %) had shoulder stiffness among the conservative group.

### **Wound Dehiscence**

In my study, one patient (5.56%) had wound dehiscence among the surgical group.

### **Keloid Formation**

In my study, 2 patients (11.11 %) had keloid formation among the surgical group.

### **Superficial Skin Infection**

In my study, two patient (11.11 %) in surgical group had superficial skin infection. It was treated with oral antibiotics for 5 days & sterile local dressings and it got cured.

### **Functional outcome:**

The functional outcome was assessed by Constant and Murley score at the time of injury, at 6 weeks, at 3 months, 6 month and 12 months and the score were significantly better in surgical group than conservative group.

In a randomized control study by Canadian orthopaedic trauma society, it was found that Constant score and DASH Scores are significantly better in surgical group at 6 weeks, 12 and 24 weeks than conservative group.

The main advantage of surgical treatment of mid-third fracture clavicle with plate is that it gives immediate pain relief, early shoulder movements, less chance of non-union and early return to work as compared to conservative treatment.

## **CONCLUSION**

In this study 36 patients with displaced mid-third fracture clavicle who presented to our hospital were randomly selected into two groups with 18 patients in each group. Every patient was followed up for 12 months.

The patients' functional outcome were assessed using Constant and Murley scoring system and it was found that patient treated surgically had significantly better functional outcome when compared to conservative group.

The complications we faced were four cases of nonunion, two cases of delayed union and five cases of shoulder stiffness in conservative group as compared to one case of wound dehiscence, two cases of superficial skin infection and two cases of

keloid formation in surgical group which were at par with the rates in standard literatures.

It was observed that patients who underwent surgical treatment had better functional outcome in terms of early ROM and they returned early to work as compared to conservative group. According to present study, surgery can be recommended over conservative treatment in patients with displaced mid-third clavicular fractures.

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