Ultrasonography Assisted Reduction Vs Blind Manipulation in Closed Reduction of Colles Fractures - A Comparative Study

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ABSTRACT

BACKGROUND

Colles fracture is the most common wrist fracture in adults, predominantly affecting elderly women. Our study intends to reinforce the role of ultrasonography assisted reduction of Colles fractures as a suitable alternative to blind manipulation, as it can verify the adequacy of reduction in a single sitting in real time, and avoid multiple reduction sessions.

METHODS

20 adult patients diagnosed with Colles fracture were enrolled in this case control study. Patients were divided into two groups of 10 each, study and control groups. The sample size was limited due to the Covid-19 pandemic of 2020. Study group was subjected to ultrasonography assisted reduction. Control group was subjected to blind manipulation and reduction.

RESULTS

Baseline characteristics between two groups were similar. The rate of repeat reduction was reduced in the ultrasound group (20 % VS 40 %; $P = .329$). The post reduction radiographic indices were similar between the two groups, although the ultrasound group had improved volar tilt (mean, 2.8° VS 1.6° ; $P = .394$). The operative rate was reduced in the ultrasound groups (10 % VS 30 %; $P = .263$). These results, though similar to existing studies into the topic, were not statistically significant, probably due to low sample size.

CONCLUSIONS

Despite the inability of our study to arrive at statistically significant results, we have positive findings for the parameters of volar tilt, number of multiple reduction attempts and number of cases proceeding to surgery. These findings are in line with other studies that were successful in establishing statistical significance for the above parameters. In view of this, a recommendation can be made to prefer ultrasonography assisted reduction over blind manipulation in initial management of Colles fractures, where the facility is available.

KEY WORDS

Colles Fractures, Ultrasonography, Blind Manipulation, Reduction, Volar Tilt, Operative Rate

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DOI: 10.14260/jemds/2022/25

How to Cite This Article:

Dasari VR, Chinta SK, Kanaparthi S, et al.
Ultrasonography assisted reduction vs
blind manipulation in closed reduction of
Colles fractures - a comparative study. *J
Evolution Med Dent Sci* 2022;11(01):132-
135, DOI: 10.14260/jemds/2022/25

Submission 26-02-2021,
Peer Review 15-01-2022,
Acceptance 22-01-2022,
Published 28-01-2022.

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BACKGROUND

Colles fracture¹ is the most common wrist fracture in adults, predominantly affecting elderly women.²

It is an extra articular fracture affecting the distal radial metaphysis, with dorsal angulation and shortening.³ The resultant deformity is known as 'dinner fork' deformity.⁴ The most common mechanism of injury is fall on an outstretched hand.⁵

Blind manipulation and reduction may be inaccurate and hence, multiple reduction attempts maybe needed. This will cause discomfort to the patient. It can result in soft tissue injury, patient discomfort and additional investment in personnel, time and resources. The method of analgesia that can be employed for the reduction of this fracture is a haematoma block.⁶ The effect of this block is temporary, and multiple prolonged attempts at reduction may cause the analgesia to dissipate, leading to increased pain with each reduction attempt. It is therefore vital to minimize the number of reduction attempts. However, this is not always possible for an inexperienced surgeon attempting to reduce this fracture blindly. Also, if the blind manipulation and reduction was carried out in the operating room under anaesthesia, multiple reduction attempts may cause prolonged anaesthesia time and increases chances of related complications. Ultrasonography can offer valuable assistance to prevent this scenario.

Traditionally, the fracture is reduced blindly, or under fluoroscopy guidance, under local or regional anaesthesia, followed by post reduction radiographs to assess the adequacy of reduction.⁷

Fluoroscopy can cause radiation exposure,⁸ and the necessary hardware is cumbersome and may not be available in every center.⁹ High intensity fluoroscopy may cause skin burns,¹⁰ while cumulative radiation exposure over several years may cause malignancy.¹¹ Despite the excellent images that fluoroscopy can provide, its radiation risks make it worthwhile to seek an alternative. The surgeon has more risk due to cumulative exposure over several years, in comparison to the patient who is usually exposed to fluoroscopy only once in his life. It is thus irrational to use fluoroscopy for fractures which can be reduced in an outpatient setting, if an alternative method of reduction is made available.

Hence, ultrasonography assisted reduction was examined as a probable alternative. It has no risk of radiation exposure. The necessary hardware is also available in rural areas,¹² and is not cumbersome to use, in comparison with fluoroscopy. Also, the fluoroscope is expensive and its usability is questionable in a primary health centre. An ultrasonography machine can be repurposed to serve multiple specialties and has much more utility for a primary care hospital. If ultrasonography can be repurposed to aid in the reduction of Colles fractures, it can potentially enable personnel in primary care hospitals to reduce this fracture accurately, and avoid complications related to malreduction and multiple reduction attempts. It can also potentially reduce the referrals to higher centres as a consequence of malreduction, and the subsequent complications which may arise.

Our study intends to reinforce the role of ultrasonography assisted reduction of Colles fractures as a suitable alternative to blind manipulation, as it has the

potential to verify the adequacy of reduction in a single sitting in real time, and to avoid multiple reduction sessions.

METHODS

The study was a case control study, conducted in the Department of Orthopaedics, Government General Hospital, Siddhartha Medical College, Vijayawada, Andhra Pradesh.

The period of study was from November 2018 to November 2020. Ethical Committee clearance was obtained from the Institutional Ethics Committee at our College. Written informed consent was obtained from all participants.

A sample size of 60 patients was planned. However, this had to be reduced to 20 owing to the dearth of clinical material following the Covid-19 pandemic of 2020.

Inclusion Criteria

Patients above 18 years of age with clinically and radiographically diagnosed Colles fractures.

Exclusion Criteria

Neurovascular compromise, open fractures, age less than 18 years, poor compliance, and polytrauma.

Procedure

20 adult patients diagnosed with Colles fracture were enrolled in the study. Patients were divided into two groups of 10 each, study and control groups. The sample size was limited due to the Covid-19 pandemic of 2020. Study group was subject to ultrasonography assisted reduction. Control group was subjected to blind manipulation and reduction.

Antero - posterior, lateral radiographs of the wrist was first obtained for fracture confirmation. Analgesia was then provided using hematoma block.¹³ For the study group, pre - reduction ultrasonogram of the fracture site is then obtained by visualizing using 7.5-megahertz linear array probe¹⁴ by orienting the probe along the longitudinal plane along the dorsal and radial aspects of the radius. No such assessment was done for the control group.

Following this, fracture was reduced as usual using traction - counter traction and manipulation.¹⁵ Post reduction, fracture site was visualized and the reduction was assessed using ultrasonography for the study group.

If proximal and distal cortices were aligned in a straight line, it meant successful reduction. If not aligned, reduction and ultrasonography were repeated as often as needed until the cortices are aligned.

Post reduction radiographs were then obtained for both groups, and adequacy of reduction was assessed. The acceptable criteria¹⁶ for successful reduction was volar tilt > 0 degrees, radial inclination of 15 - 25 degrees and radial height >5 mm. If reduction was insufficient on post reduction radiographs, another attempt was made. Final decision regarding operative or conservative management was made by the orthopaedics assistant professor, following evaluation of post reduction radiographs.

The following parameters were compared between study and control groups –

1. Post reduction radiological indices (volar tilt, radial height, radial inclination)
2. Number of reduction attempts.
3. Final management (conservative, operative)

Description of Radiological Indices

1. Volar tilt -It is a measurement made on the lateral projection of the wrist as an angle of the distal radial surface with respect to a line perpendicular to the shaft. A normal range is considered at around 10-25°¹⁷
2. Radial height – It is the distance between two lines drawn perpendicular to the long axis of the radius on the AP projection from the apex of the radial styloid and level of the ulnar aspect of the articular surface.¹⁸
3. Radial inclination - It is a measurement made on the AP projection of the wrist as an angle of the distal radial surface with respect to a line perpendicular to the shaft. A normal range is considered at around 21-25°.¹⁹

Statistical Analysis

Results were analysed using SPSS 22 statistical analysis. For categorical data, chi square test was used to determine significance. For numerical data Student t test was used to test for significance.

RESULTS

The baseline characteristics of the two groups are depicted in Table 1. There is no statistically significant difference between these two groups on the basis of these characteristics.

Table 2 shows post reduction fracture indices. The radial inclination and radial height were similar for both groups post reduction. The volar tilt was noticeably better in the study group (2.8° vs 1.6°), but this was not statistically significant. (P= 0.394, not significant at P<0.05).

Table 3 shows the reduction outcomes. There is a noticeable decline in the number of multiple reduction attempts (2 vs 4) in the study group (P=0.329). The number of cases proceeding to surgery were also lower (1 vs 3) in the study group vs control group (P=0.263). However, none of these results were statistically significant at P<0.05.

		Ultrasono- graphy (%)	Blind Manipulation (%)	P
Average age		52.8	55.5	0.516
Sex	Male	4 (40)	4 (40)	1
	Female	6 (60)	6 (60)	
Mechanism of trauma	Road traffic accident	2 (20)	1 (10)	0.531
	Accidental fall	8 (80)	9 (90)	
Side of fracture	Right	3 (30 %)	2 (20 %)	0.605
	Left	7 (70 %)	8 (80 %)	
Fracture indices	Volar tilt	- 15.6	- 17.6	0.172
	Radial inclination	13	14.1	0.409
	Radial height	6.3	6.8	0.597

Table 1. Baseline Characteristics (significant at P<0.05)

Fracture Indices	Ultrasonography	Blind Manipulation	P
Volar tilt	2.8	1.6	0.394
Radial inclination	16.2	16.7	0.559
Radial height	10.9	10.8	0.661

Table 2. Post Reduction Radiographic Indices (significant at P<0.05)

Parameter		Ultrasono- graphy (%)	Blind Manipulation (%)	P
Number of reductions	1	8 (80 %)	6 (60 %)	0.329
	>1	2 (20 %)	4 (40 %)	
Final management	Conservative	9 (90 %)	7 (70 %)	0.263
	Surgical	1 (10 %)	3 (30 %)	

Table 3. Reduction Outcomes (significant at P<0.05)

Study	Average Volar Tilt Ultrasonography Assisted Reduction	Blind Manipulation	P Value
Ang et al. ²⁰	5.93	2.61	0.048
Sabzgabhaei et al. ¹⁶	7.6	3.7	0.001
Present study	2.8	1.6	0.394

Table 4. Post Reduction Volar Tilt vs Other Studies

Study	Reduction Attempts				P Value
	Ultrasonography		Blind		
	Assisted Reduction		Manipulation		
	1	>1	1	>1	
Sabzgabhaei et al. ¹⁶	59 (90.8)	6 (9.2)	49 (75.4 %)	16 (24.6)	0.014
Ang et al. ²⁰	61 (98.4)	1 (1.6)	93 (91.2)	9 (8.8)	0.056
Present study	8 (80 %)	2 (20 %)	6 (60 %)	4 (40 %)	0.329

Table 5. Reduction Attempts vs Other Studies

Study	Final Management				P Value
	Ultrasonography Assisted Reduction		Blind Manipulation		
	Surgical	Conservative	Surgical	Conservative	
Ang et al. ²⁰	3	59	17	85	0.019
Sabzgabhaei et al. ¹⁶	7	58	18	47	0.014
Present study	1 (10 %)	9 (90 %)	3 (30 %)	7 (70 %)	0.263

Table 6. Final Management vs Other Studies

DISCUSSION

In the present study, we discovered a noticeable improvement in the post reduction volar tilt in the study group. There was also a reduction in the number of multiple attempts and in the number of cases proceeding to surgery in the study group. This is in line with other studies^{16,20,21} into the topic, which established statistically significant improvements in the above mentioned parameters. These findings are detailed in the following tables, with P<0.05 considered significant.

However, this statistical significance could not be proven in the present study. This could be due to the low sample size, which could have resulted in abnormally high p values.

Ultrasonography has already been established as an effective tool in detecting long bone fractures, particularly in paediatric population.²² It is also being used in detecting wrist fractures.²³ The technique of ultrasonography for detecting fractures is simple enough, that even nurses can detect fractures using it.²⁴ The ultrasonography machine is also more abundant in smaller hospitals, compared to any other imaging modality,²⁵ and is free from the issue of radiation exposure that plagues fluoroscopy machines.²⁶

As other studies have shown,¹⁶ blind manipulation and reduction can result in multiple reduction attempts, more need for post reduction radiographs, increased patient discomfort, and radiation exposure, in comparison with ultrasonography assisted reduction. Ultrasonography also offers the advantage of real time observation while reducing the fracture. A major drawback of ultrasonography is its inability to penetrate bone,²⁷ making it unsuitable for the reduction of intraarticular fractures. Also, some studies²¹ have documented a phenomenon where the cortices appear aligned under ultrasonography, but later turns out

misaligned on radiographs. But this is assumed to be operator dependent. Despite the inability of our study to arrive at statistically significant results, it is noteworthy that in the study group, we have positive findings for the parameters of volar tilt, number of multiple reduction attempts and number of cases proceeding to surgery. These findings are in line with other studies that were successful in establishing statistical significance for the above parameters. In view of this, a recommendation could be made to prefer ultrasonography assisted reduction over blind manipulation in initial management of Colles fractures, where the facility is available.

CONCLUSIONS

Ultrasonography can be considered a suitable guidance tool for the reduction of distal radius fractures.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jemds.com.

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