International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(2): 161-164

www.orthopaper.com
Received: 06-01-2020
Accepted: 10-02-2020

Dr. Suhas
Study Done at Department of Orthopaedics, A.J Institute of Medical Sciences, Mangalore, Karnataka, India

Dr. Mithun Shetty
Study Done at Department of Orthopaedics, A.J Institute of Medical Sciences, Mangalore, Karnataka, India

Dr. Anusree Anil Kumar
Study Done at Department of Orthopaedics, A.J Institute of Medical Sciences, Mangalore, Karnataka, India

Corresponding Author:
Dr. Suhas
Study Done at Department of Orthopaedics, A.J Institute of Medical Sciences, Mangalore, Karnataka, India

Avoiding iatrogenic radial nerve jeopardy during humerus fixation by unshackling the nerve: A Study of simple and effective technique

Dr. Suhas, Dr. Mithun Shetty and Dr. Anusree Anil Kumar

DOI: https://doi.org/10.22271/ortho.2020.v6.i2c.2031

Abstract
Background: Radial nerve is prone for iatrogenic injury during open reduction and fixation of humerus fractures. The Lateral Intermuscular Septum (LIS) acts like a rigid noose around the nerve and prevents free mobilization of nerve during the process of surgical fixation. Hence this study is conducted in an attempt to verify the chances of nerve injury when the lateral intermuscular septum is released.
Material and methods: A total of 39 cases of shaft of humerus fractures were studied. All the cases were free of preoperative radial nerve injury and underwent plate fixation via anterolateral approach. A simple maneuver of lateral intermuscular release was done in all these cases. Appropriate proforma was made and data was expressed in percentages.
Results: There was no incidence of iatrogenic radial nerve injury in any of these cases.
Conclusion: Unshackling the radial nerve by releasing Lateral intermuscular septum would improve the excursion thereby circumventing the possibility of iatrogenic radial nerve injury.

Keywords: Iatrogenic, radial nerve palsy, humerus fixation, unshackling

Introduction
Radial nerve injury is commonly associated with Humerus shaft fractures. It can be damaged during the traumatic event or while management. Iatrogenic radial nerve injury is as high as 6% to 32% after surgical plate fixation, which is an alarming incidence [1]. This appalling statistic necessitates trauma surgeons to scrutinize and improve upon the existing surgical techniques in view of reducing the chances of iatrogenic radial nerve palsy. High incidence of radial nerve injury is due to its proximity to the bone in the spiral groove and due to a fixed point in its anatomical course as it penetrates the Lateral Intermuscular Septum which limits the mobility of the nerve [2].
Open reduction and surgical plate fixation for shaft of humerus fractures generally utilizes anterolateral (Fig 1) or posterior approach. It is imperative to have a sound knowledge about anatomy of radial nerve to prevent injury in both these approaches.
Radial nerve as it courses along the spiral groove is in close proximity with the shaft of humerus. Further it descends to penetrates the lateral intermuscular septum before entering the anterior compartment of the arm at about 10-12cm proximal to lateral epicondyle (Fig 2) [3]. Lateral intermuscular septum is a rigid structure spread out from greater tuberosity to lateral epicondyle separating the two compartments *viz* anterior and posterior [4]. This decreases free mobility of the nerve and hence making it prone for traction injuries.
Iatrogenic radial nerve palsy might occur due to manipulation of fracture during reduction, direct injury caused by surgical instruments and traction injury secondary to use of retractors and levers [5]. There are two possible ways to decrease the chances of iatrogenic injury. Firstly, the well documented method of knowing the anatomical course of the nerve aiding in isolating the nerve before manipulating the fracture or the use of retractors in an open surgery [6]. There is a second more logical method of improving the excursion of nerve by releasing the LIS. This reduces the chance of traction injury on the nerve during manipulation or use of retractors. LIS release has proven to improve radial nerve excursion in cadaveric studies [7]. Reflecting the periosteum along with LIS using a periosteal elevator along the lateral border of humerus in the distal fracture fragment relaxes the radial nerve.

Farabeufs or cobb's elevator can be used to reflect the LIS beyond the supracondylar ridge without any need of visualizing the nerve (Fig 3). This simple maneuver would increase the mobility of nerve and prevent traction injury, what we call as the phenomenon of "unshackling".

In this study we analyze cases of humerus shaft fixation without any preoperative neurologic injury where unshackling of the nerve has been done. Immediate post-operative neurologic status of the radial nerve was assessed to study the effectiveness of the maneuver.

Material and Methods

The current study included 39 patients who sustained humerus shaft fractures presenting to us between the year 2016-2019.

Isolated humerus shaft fractures involving one limb without any clinical evidence of pre-operative radial nerve palsy were included in the study. Patients with involvement of contralateral limb, presence of injuries in forearm and hand, presence of brachial plexus, cervical and head injuries and presence of any systemic neuropathic conditions were excluded from the study. There was no clinical evidence of radial nerve palsy in both the upper extremities of selected cases.

Pre-operative and post-operative clinical assessment of radial nerve was done by sensory and motor examination of radial nerve at the level of hand and wrist by the same evaluator for all the patients. Sensory evaluation of first web space was done and compared with the normal side. Motor strength of wrist dorsiflexion, thumb extension at interphalangeal joint and extension of fingers at metacarpophalangeal joints were evaluated and compared with the uninvolved limb.

The Lateral intermuscular septum was released during the process of surgical humeral fracture fixation by anterolateral approach in all these cases. Pre-operative and post-operative neurologic status assessed and documented.

A rational questionnaire was constructed to gather relevant data after reviewing related literature. The data was expressed in the form of percentages and mean.

Surgical procedure

Surgical incision of approximate 10-12 cm in length is made along the lateral border of biceps with arm placed in hand table in supine position**.** Soft tissue is dissected and interval between the biceps and the brachialis is identified. Musculocutaneous nerve is identified on undersurface of biceps. Proximal fracture fragment is exposed along the delto-pectoral interval. Biceps is retracted medially and brachialis in the distal fracture fragment is split in the midline along the length of the muscle fibres and elevated sub-periosteally. Staying in the sub periosteal plane the periosteal elevator is run distally towards the supracondylar ridge maintaining contact with the bone. (Fig 2) Although it is relatively a blind procedure, since the instrument runs along the bone sub-periosteally, it avoids inadvertent injury to the radial nerve. This is followed by reduction and fixation of the fracture. We do not isolate and directly visualize the radial nerve before fixation (Fig 4).

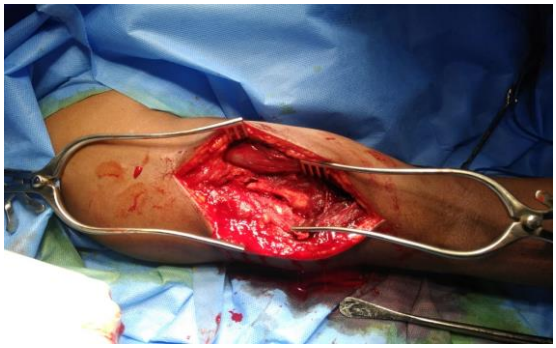

Fig 1: Exposure of humerus shaft fracture by Anterolateral approach

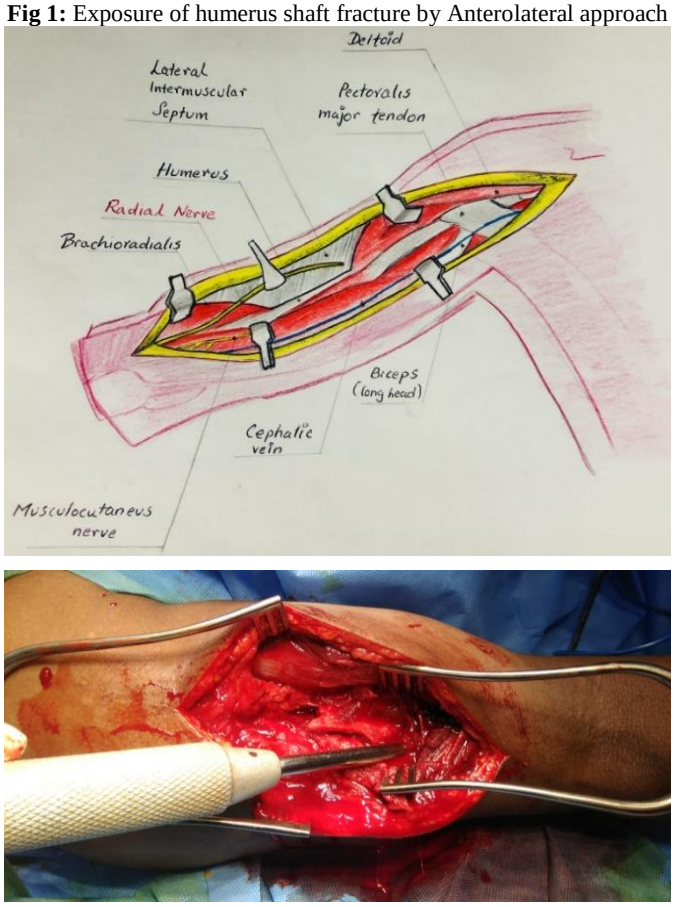

Fig 2: Releasing the Lateral intermuscular septum by sub-periosteal elevation

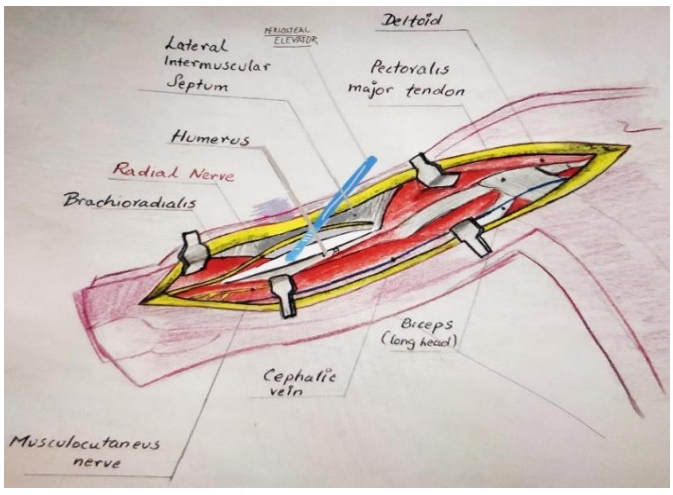

Fig 3: Radial nerve relaxes with sub-periosteal release

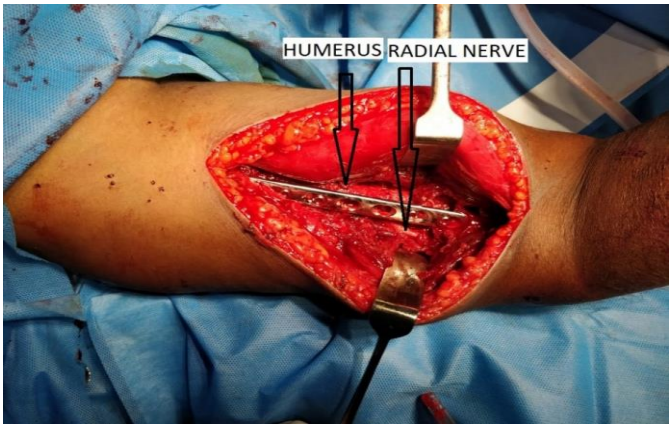

Fig 4: Radial Nerve visualized after placement of humerus plate

Results

Table 1: Age group percentage

Age (in years)	Number	Percentage
<5o years	36	92.3%
>50 years	3	7.7%

Table 2: Percentage of male and female

Gender	Number	Percentage
Male	33	84.6%
Female	6	15.4%

Table 3: Hand dominance Percentage

Hand dominance	Number	Percentage
Right	21	53.8%
Left	18	46.2%

Table 4: Garnavos Classification (Morphological)

Fracture pattern	Number	Percentage
Simple transverse	14	35.9%
Simple spiral	2	5.1%
Intermediate	20	51.2%
Complex	3	7.6%

Table 5: Use of retractors and levers in Percentage

Instruments	Number	Percentages
Retractors	14	36%
Levers	16	41%
Both	9	23%

Table 6: Radial nerve injury Percentage

Radial nerve injury	Number (total=)	Percentage
Intact pre-op	39	100%
Intact post-op	39	100%

Out of the 39 patients evaluated, more than 90% of patients were over the age of 50 years, with 84% patients being male. Both right and left side was almost equally involved with majority of fractures being of intermediate type as per Garnavos classification. Radial nerve was found to be intact in all patients after surgery.

Discussion

Iatrogenic radial nerve palsy occurring during surgery is an important complication in humeral shaft fracture fixations. Relatively high incidence of secondary nerve palsy occurs approximating to about 7% and more [1].

In this study we have evaluated 39 patients of humerus shaft fixation operated by anterolateral approach who underwent unshackling of radial nerve during the procedure. In this study there were 33 males (84.6%) and 6 females (15.4%). Most of the patients belonged to younger age group of less than 50years (92.3%) with a mean age of 36.2 years. Right humerus was involved in 21 patients (53.8%). Fracture pattern was assessed using Garnavos Morphological Classification. Maximum type of fractures was of the intermediate type followed by simple transverse. Post operatively radial nerve was found to be intact in all patients.

In a similar study done by Schwab *et al*. had patients with mean age of 45 in group of patients who had secondary nerve palsy [1]. Many literatures have made an attempt to understand the cause of iatrogenic nerve injury and discussed various ways which can be followed to reduce its chances. Sud, J P Khatri *et al*. in their study have proposed that there is increased risk of radial nerve injury with lateral plating of humerus contemplating that this can be reduced by medial plating. Sud *et al*. in his study, attributed traction and manipulation done during anterolateral plating as an important factor for radial nerve injury. It was suggested that plating on medial surface of humerus would reduce the incidence [8]. However nutrient artery foramina are more consistently found on the medial surface of humeral shaft in the middle third of humerus and hence there is a theoretical possibility of medial plating affecting the chances of union [9]. Since medial surface is not considered a tensile surface, medial plating also has biomechanical disadvantages. In this particular study we have used conventional lateral plating. Although conservative treatment with hanging cast or alkathene brace can reduce the chances of iatrogenic nerve injury, it is never considered a feasible option for early mobility and functional recovery. Closed intramedullary nailing is known to reduce the chances of radial injury but never considered foolproof. Chances of radial nerve injury is also present during closed procedures like intramedullary nailing. It is more likely to occur during distal locking. Wayne *et al*, in their cadaveric study demonstrated radial nerve excursion can be improved by releasing the lateral intermuscular septum and keeping elbow in flexion and thereby can help in reducing the chances of traction injury [7]. However, there are no existing literature to prove benefits of this study in a clinical setting. Reichert p *et al*. classified the three types of iatrogenic injury as per their observation; compression, rupture with <1cm gap and rupture with >1cm gap [10]. According to this article iatrogenic injuries occurred due to sharp bone fragments, during reduction and plating maneuvers, and during screw placement. Schwab *et al*. in their study discussed about injury occurring due to excess movement of fracture fragments while positioning the limb under anesthesia and also due use of Hohmann retractors laterally in the distal fracture fragment [1]. This explains the possibility of traction injury on the nerve. In our study we have used both Langhaenback and Hohmanns retractors in variable combinations once the LIS was released and hence not affecting the radial nerve.

Intra-operative radial nerve injuries can be prevented by good understanding of anatomy and knowing the danger zones where radial nerve is likely to be injured [2] Direct injury to the radial nerve can be avoided by visualizing the nerve during plate placement, avoiding clamping of bone along with the nerve while using reduction clamps and preventing overambitious retractions by levers and retractors [6]. In our study, we have not made a willful attempt in isolating the

radial nerve prior to reduction and plating. However, by releasing the LIS we have unshackled the nerve to render free mobility and thereby reducing the chance of iatrogenic injury.

Limitations

It needs to be assessed whether the elevation of periosteum leads to delayed union or non-union of fracture shaft of humerus. Our study doesn't include the follow up of fracture since it's a cross sectional study. This study was conducted in a small sample size hence there is a need to improve research in this aspect with increased sample size. Since this is not a randomized study and there is no comparison done with a control group, the strength of the study remains weak. Hence research should improve on this innovative technique by conducting an effective sized randomized control trial to have a conclusive evidence on the reliability of this technique.

Conclusion

Unshackling the radial nerve by releasing Lateral intermuscular septum would improve the excursion thereby circumventing the possibility of iatrogenic radial nerve injury.

Source of funding: Nil
Conflict of interest: Nil

References

1. Schwab TR, Stillhard PF, Schibli S, Furrer M, Sommer C. Radial nerve palsy in humeral shaft fractures with internal fixation: analysis of management and outcome. European Journal of Trauma and Emergency Surgery. 2018; 44(2):235.
2. Bono CM, Grossman MG, Hochwald N, Tornetta III P. Radial and axillary nerves: anatomic considerations for humeral fixation. Clinical Orthopaedics and Related Research®. 2000; 373:259-64.
3. Rocchi M, Tarallo L, Mugnai R, Adani R. Humerus shaft fracture complicated by radial nerve palsy: Is surgical exploration necessary?. Musculoskeletal surgery. 2016; 100(1):53.
4. Bowman J, Curnutte B, Andrews K, Stirton J, Ebraheim N, Mustapha AA. Lateral intermuscular septum as cause of radial nerve compression: case report and review of the literature. Journal of surgical case reports. 2018; (8):2.
5. Aksu N, Karaca S, Kara AN, Işıklar ZU. Minimally invasive plate osteosynthesis (MIPO) in diaphyseal Humerus and proximal Humerus fractures. J.
6. Ji F, Tong D, Tang H, Cai X, Zhang Q, Li J, Wang Q. Minimally invasive percutaneous plate osteosynthesis (MIPPO) technique applied in the treatment of humeral shaft distal fractures through a lateral approach. International Orthopaedics. 2009; 33(2):543-7.
7. Chen WA, Luo TD, Wigton MD, Li Z. Anatomical Factors Contributing to Radial Nerve Excursion at the Brachium: A Cadaveric Study. The Journal of hand surgery. 2018; 43(3):288-e1.
8. Sud A, Sood M, Ghai A, Khatri JP. Lower radial nerve palsy in mid shaft humerus fracture using medial plating. Journal of Marine Medical Society. 2017; 19(2):114.
9. Carroll SE. A study of the nutrient foramina of the humeral diaphysis. The Journal of bone and joint surgery. British volume. 1963; 45(1):181.
10. Reichert P, Wnukiewicz W, Witkowski J, Bocheńska A, Mizia S *et al*. Causes of secondary radial nerve palsy and results of treatment. Medical science monitor: international medical journal of experimental and clinical research. 2016; 22:554.