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Corresponding Author:

Dr. K. Venkatachalam

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RETROSPECTIVE STUDY OF THE CLINICO-FUNCTIONAL OUTCOME OF ANTEGRADE INTER-LOCKING NAILING VERSUS DCP FOR SURGICALLY INTERVENED HUMERAL DIAPHYSEAL FRACTURES IN ADULTS

J. Dheepak Chandru¹, N. Ajit Kumar², K. Sulthan Basha³, P. Ramesh Vyravan⁴

¹MS Ortho PG, Department of Orthopaedics, Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy, Tamilnadu, India.

²Assistant Professor, Department of Orthopaedics, Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy, Tamilnadu, India.

³Assistant Professor, Department of Orthopaedics, Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy, Tamilnadu, India.

⁴Professor and HOD, Department of Orthopaedics, Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy, Tamilnadu, India.

Abstract

Background: Diaphyseal fractures of the Humeral bone constitutes, to around five percent of all adult fractures. The Humerus is a bone, to which thirteen muscles get attached, which directly or indirectly, influence the movements of the elbow and the hand, hence in short reflect upon the functionality of the upper extremity. Unless, there are pressing co-morbidities in a patient, conservative management of open Humeral Shaft Fractures, are slowly moving into Oblivion. With due respect to Stalwarts like Dr. Augusto. P. Sormiento, who popularized the concept of "Functional Cast Bracing", the developments in the instrumentation and implantology, has since seen a "Sea Change". The newer generation implants and the patients demand for restoration of pre-injury level of "QOL", have necessitated Surgical Interventions, for the open Fractures of Humeral Diaphysis. We the Modern Day Orthopaedic Surgeons, have to keep the pace with all such "Recent Advances". The literature is full of contradictions, with regard to choice of the Right Implant and no concrete "Thumb Rule" exists, with regard to the "Perfect Choice of Implant" for the Humerus. In this Retrospective Study, spanning a period of 6 years, in a Tertiary Teaching Medical Hospital, with a fairly reasonable recruit number of 92 patients, we have made an effort to compare AIILN vs DCP for open Humeral Diaphyseal fractures. We are aware that, the initial experience with ILN for Humerus was not comparable to the success story, it had with the Tibial Fractures. Rigid internal fixation with intramembranous ossification, is slowly paving the pathway for "Micro-Movement Friendly" Implants, which deliver both intramembranous and endochondral ossification. The mantra that "Load Sharing Devices" are preferable to "Load Bearing Devices", need not be reiterated, in this present context. Our study has only included open Gustillo-Anderson Grade 1 to Grade 3C Humeral Diaphyseal Fractures. We have evaluated the functional outcomes by using the ASES Scoring System compared, the AIILN to the DCP, and have shown 58.69% (n=27) and 28.26 % (n=13), Excellent functional outcomes, for the two respective groups. In both our Primary Outcomes, as well our Secondary Outcomes, we have been able to show some better outcomes, in the AIILN Group, when compared to the DCP Group. Many more randomised study, would be needed, before we write this verdict on the wall, in favour of AIILN. DCP has been, and always shall be, the "Orthopaedician's Friend" and is something, that has stood the test of time, ever since AO first introduced it in 1969. We would like to humbly conclude that, "If Old is Gold, then the New is Glitter ". Only further dedicated research will delve, into the Truth if the "Glitter" is indeed the new "Gold".



INTRODUCTION

Orthopaedic Trauma Centres, frequently encounter patients with Humeral Shaft Diaphyseal fractures, which account for 1.31 to 3% of all fractures.^[1] The incidence rates, have shown a Bimodal Distribution, with a slight peak during Adolescence and a greater spike, throughout the Fifth and Sixth decades of life. ^[2] In individuals older than 12 years, and younger than 3 years, the incidence of humeral diaphyseal fractures is significant.^[3] The Mid-Diaphysis, is the site of the majority of Humeral Shaft Diaphyseal Fractures.^[2]

As bony unions are achieved in both Conservative and Operative Management, the techniques to treating these injuries, have always been a bone of contention. Casts or Functional Braces, Velpeau Dressing, Coaptation Splint, might be used as Modalities of Conservative Treatment.^[4] In general, patients who have failed to achieve stable Alignment and Reduction at the fracture site, severe Segmental Fractures, Open Fractures, fractures linked to Bilateral Humeral Fractures, Forearm Fractures, on the same side, Polytrauma cases, Patients with progressive Neurological Deficits, those associated with Vascular Injury, or cases of Floating Shoulder or Elbow of the same side, should receive surgical treatment.^[5,6] Recent improvements in the operative Internal Fixation Methods and Instrumentation, have been able to establish positive results, which have led to the expansion of the Surgical Indications, for treating Humeral Shaft Diaphyseal Fractures and have sparked a fresh discussions, about the best course of Orthopaedic intervention.



Figure 1: Various Modalities of Conservative Treatment

The most common surgical techniques, that the Orthopaedic surgeon use, is either with Antegrade Intramedullary Interlocking Nail (AIILN) or Dynamic Compression Plate (DCP). Historically, plate and screw fixation has been the preferred surgical technique, and is still among the best surgical management strategies.^[7]

Currently, Humeral Shaft Diaphyseal Fractures, are treated with both of these surgical techniques; viz: AIILN and DCP. Both methods have their own Advantages and Limitations, in terms of Implant Bio-Mechanics and achieving and maintaining Length, Alignment, Rotary Stability, there by giving Anatomical Reduction leading to Sound Bony Union and are able to give Good to Excellent Clinico-Functional Outcomes. A large Intra-Operative exposure, combined with soft-tissue stripping is necessary for plating (DCP) with stable fixation and direct vision, which is proven to achieve close to precise anatomic reduction and protect the radial nerve.[8]

The radial nerve's close proximity, the need for considerable dissection, and the possibility of structural failure in osteopenic bones, make the use of the plate challenging in certain difficult situations.

There is considerable interest, in using the Humeral Antegrade Intramedullary Nail (AIILN), to treat the Humeral Shaft Diaphyseal Fractures, as a result of recent technical developments, in implantology and the success linked with nailing, in similar long bone fractures.^[9]With enhanced Biomechanics and a Load-Sharing Effect of the implant, AIILN is also, a Minimally Invasive Surgical Intervention. Since Extensive Periosteal Stripping, are avoided in AIILN surgery, fractures treated with it have a higher probability of healing well and the Fracture Haematomaitself, acting as an Autograft.^[10]

Nailing as a surgical procedure, has been so effective in treating Diaphyseal Femoral and Tibial fractures, why then the Nails cannot generate comparable results, when used on the humerus was a moot contradiction. One cause is that the Humerus has its own Intricate Anatomy and a Distinctive Bio-Mechanical properties. Furthermore, there is currently, no agreement on either Crucial Technical Issues or Fundamental Principles, of the surgical method (such Antegrade/Retrograde, as Reamed/Unreamed, Static/Dynamic) Nail Design and an established nail selection criteria .[11] Hence, our present study was undertaken to compare parameters in both surgical techniques viz ; the AIILN and the DCP, for Adult Humeral Diaphyseal **Open** Fractures.

Aim and Objectives

To compare Pre-operative, Intra-operative, and Post-Operative Parameters, with regard to the Fracture Geometry, Duration of Surgery, Loss of Blood, the Incidence of Complications and the Mean Union Time, for bony consolidation among patients, surgically intervened for Humeral Shaft Diaphyseal Fractures, addressed by the Antegrade Intramedullary Interlocking Nail (AIILN) and the DCP (Dynamic Compression Plate).

MATERIALS AND METHODS

This Retrospective Study, was done at the Department of Orthopaedics, Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy – 621105, among patients with Open Humeral Shaft Diaphyseal Fractures. This was

a Retrospective Study, undertaken from January 2017 to December 2022. There was a minimum follow up period of 2 years (Range:24 to 71 months). Thus, this study was spanning across a time interval of 6 years of which, the initial 4 years alone, was considered to be a Recruitment Period and the subsequent 2 years, was limited to Systematic Follow - Up, of the cases, which were operated, during the period of Recruitment.

Inclusion Criteria

- Diaphyseal Humeral Shaft Fractures of both the sex and of the age between 26 to 55 years.
- Only, Open Gustilo Anderson Type I to III A, with or without Radial Nerve Injury.
- Fractures with the fracture line lying 3cm beyond the surgical neck of the humerus and 4 cm proximal to the tip of Olecranon Fossa.

Exclusion Criteria

- Pathological Humeral Shaft Diaphyseal fractures, Malunited Fractures and Non-Unions.
- Fractures of humeral shaft associated with ipsilateral proximal humeral intra articular fractures.
- Ipsilateral AC joint disruption,
- Ipsilateral elbow fracture dislocation,
- Ipsilateral forearm fractures.
- Ipsilateral distal radial fractures.
- Patients reporting beyond 2 weeks of the Injury.



Calculation of Sample Size and Mode of Distribution

Ninety-two participants were selected, by Simple Random Sampling method, based on the formula 4pq/d2. The proportion of good functional outcome among patients with Diaphyseal humeral fracture managed by DCP was 87.5% by Changulani M et al(12). Based on this proportion, 80% power and 7% of absolute precision, the final sample estimated was 92.

Data were collected using case records available at the MRD section of, Trichy SRM Medical College Hospital and Research Center, of patients with Humeral Shaft Diaphyseal Fractures, who had undergone surgical management. The participants were all allocated equally into two groups, named Group A and Group D, either they were manged with Antegrade Intramedullary Interlocking Nail [AIILN] {(n = 46, male(34) and female (12)} or DCP nail {(n = 46, male(29) and female (17)}. The Clinico-Functional outcomes were evaluated at the end of 12 months based on the ASES Shoulder Score.

ASES Shoulder Score	
Name Are D	lada
1. Usual Work	2. Usual Sport'Leisure activity?
3. De yeu have shoulder pain at night?	4) Do you take pain killers such as paracetamel (acetaminophen), diclofer
O Yes	O Yes
O No	O No
fer m	
1) Do you take strong pain killers such as codeine, tramadol, or morphine?	6) How many pills do you take on an average day?
V m	_
7) Intensity of pain?	
0 10 O9 O8 O7 O6	O5 O4 O3 O2 O1
Pain as bad as it can be	
8) Is it difficult for you to put on a ceat?	9) Is it difficult for you to sleep on the affected side?
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Surgical Protocol

The participants had all undergone, Clinical Examination, Radiological Assessment and Anaesthetic assessment Pre-Operatively. The fractures were classified based on AO/OTA Fracture and Dislocation classification.^[13], by Clinical and Radiological Assessment. All the Open Fractures had undergone Wound Debridement, and the surgical management was planned with specific parentral antibiotic coverage, vizCefoperazone + Sulbactam 1.5 gm and Amikacin 1 gm calculated for the patient's weight and administered parentrally.

DCP was implanted using a Posterior or Antero-Lateral Approach. Depending on the type of fracture, AO 4.5 mm, 8 holed DCP plates were employed, with varying lengths, among the Group D participants. In group A (AIILN), Reamed Antegrade Intramedullary Interlocking Nails, that were suitably matched to the patient's humeral length, were employed. The proximal portion of the nails all had a 5° bend. These nails, are not so expensive and are also widely available. Two screws were located proximally and 2 were secured Distally, on the Nail. The Distal Screw being positioned in an Antero-Posterior direction and the other directed Transversely, while one proximal screw was angled Transversely and the other was passed Obliquely. To make the Deltoid Muscle easier to dissect, a 4 to 5 cm incision, was created on the side of the Acromion. Retracting the Supraspinatus tendon and exposing the Greater Humeral Tuberosity's posterior edge. An awl was then used, to make the entry hole. The entry point on the proximal humerus, is determined by using the ' C ' arm, at the Zenith of the Head of Humerus, as observed in the Grashey view and centred in the AP as seen in the Precipice view. Reaming was used to gradually widen the canal of the humeral medulla, after the guiding pin was inserted. All care is taken, to preserve the Rotator Cuff Tendon and preserving the Foot Print. To avoid damaging the radial nerve, Cortical Contact was ensured, at the fracture site during reaming. To prevent distraction at the fracture site, the fracture site was being continuously monitored, under an Image Intensifier, after the nail had been passed through the canal. The Free Hand Method, was used to secure the Distal Screws. The entrance holes were identified, using an Image Intensifier, then stab incisions were made and the soft-tissue was bluntly dissected, until reaching the periosteum of the humeral bone in order, to avoid damaging the Neuro-Vascular Systems. The target device, was then secured and the Proximal Screws, were secured, one after the other.

The efficacy of the Reduction and any Iatrogenic Complications, were determined by examining, a Post- Operative Check Radiograph. The upper limb was put in an arm sling after surgery, and on the second post-operative day, after removal of the DT in case of Group D, pendulum and elbow movements were permitted. Once the patient was comfortable, the wound was healthy, and if the patient was afebrile, the patient was discharged on POD 5. Parentral antibiotic usage duration was decided, on a case to case basis. Suture removal was usually done on POD 12. Patients were evaluated Clinically and Radiologically at the end of 2, 6, 12, 24, and 36 weeks, with the final follow-up coming at 52 weeks. The patients underwent a clinical examination at every check-up, to look for any complications. This included looking for evidence

of infection, discomfort, shoulder and elbow ROM and any, Neuro -Vascular deficit. The clinical outcome was evaluated using Radiological Fracture Geometry, Duration of Surgery, Blood Loss Intra-Operatively. The incidence of complications and the mean union time for bony consolidation, were all recorded. The American Shoulder and Elbow Surgeons (ASES) score, was used to evaluate the Functional Outcomes, at the end of a year, for 10 Activities of Daily Life, that required Shoulder and Elbow Movements.

Bridging callus in Two Planes, was used to define Radiological Union. Fracture Healing, before four months was considered apt union time (AUT), Delayed union was construed, to be within, Four to Six months, after the surgery, and Non-Union was construed to have taken place after Nine months of surgery.

The Data was entered in Microsoft Excel 2019 and Analysed using software SPSS (Statistical Package of Social Sciences) version 21. Continuous variables and categorical variables were interpreted, using Frequencies (mean \pm SD) and proportions (%). Participants were informed about the study and informed consent was obtained. This study was approved by Institutional Ethical Committee (IEC), after approval from Institutional Research Board (IRB) of Trichy SRM Medical College Hospital and Research Centre.

RESULTS

This retrospective study was undertaken among patients with Humeral Diaphyseal Fractures surgically managed by AIILN or DCP, and their results were compiled and compared.

Table 1: Baseline characteristics of participants							
S No :	Variables		Group A (n = 46)	Group D (n = 46)	Total		
		26 - 35 years	26 - 35 years				
1	Age	36 – 45 years	36 – 45 years	37 (80.43%)	77		
		46 – 55 years	46 – 55 years	5 (10.86%)	7		
2	Gender	Male	Male	4 (8.6%)	8		
		Female	Female	29 (63%)	63		
		Fall from standing height	Fall from standing height	17 (37%)	29		
3	Mode of injury	RTA	RTA	6 (13%)	12		
		Assault	Assault	37 (80%)	74		
				3 (6.5%)	6		

[Table 2], shows Type of Fracture Distribution, based on AO classification among patients. The Major type of fracture among patients was found to be A3, Simple Transverse Fractures, based on AO/ OTA classification

Table 2: Type of fracture distribution based on AO classification (n = 92)						
S No :	AO Fracture Type	Group A (n1 = 46)	Group D (n2 = 46)	p value n1 + n2 =N		
1.	A1 (Simple Wedge)	0	0	0		
2.	A2 (Simple Oblique)	12 (26.08%)	1 (2.17%)	13		
3.	A3 (Simple Transverse)	20 (43.47%)	27 (58.69%)	47		
4.	B1 (Spiral Wedge)	0	0	0		
5.	B2 (Spiral Oblique)	11 (23.91%)	0	11		
6.	B3 (Fragmental Wedge)	1 (2.17%)	1 (2.17%)	2		

7.	C1 (Complex Spiral)	1 (2.17%)	15 (32.6%)	16
8.	C2 (Complex Segmental)	1 (2.17%)	1 (2.17%)	2
9.	C3 (Complex Irregular)	0	1 (2.17%)	1

[Table 3] exhibits Open Fracture Distribution, based on Gustillo Anderson classification. The higher proportion of the patients had Grade 2 fracture, among AIILN group and DCP group.

Table 3: Open fracture distribution based on Gustillo Anderson classification (n = 92)						
	Gustillo	Group A	Group A	Group D	Group D	
S No :	Anderson	Male	Female	Male	Female	
	classification	(n = 34)	(n = 12)	(n = 29)	(n = 17)	
1	Grade 1	10 (29.41%)	3 (25%)	6 (20.68%)	4 (23.52%)	
2	Grade 2	12 (35.29%)	5 (41.66%)	9 (31.03%)	7 (41.17%)	
3	Grade 3A	6 (17.64%)	1 (8.33%)	10 (34.48%)	2 (11.76%)	
4	Grade 3B	3 (8.82%)	1 (8.33%)	2 (6.89%)	3 (17.64%)	
5	Grade 3C	3 (8.82%)	2 (16.66%)	2 (6.89%)	1 (5.88%)	



[Figure 3], shows Functional Outcome, based on ASES scoring. 58.69% of patients in AIILN group and 28.69% of patients in DCP group had excellent functional outcome (75 - 90 points).

[Table 4], exhibits Functional Outcome, based on ASES scoring among groups. The Group A participants had higher proportion of ASES score of 75-90 (Excellent outcomes) and the p value was found to be, statistically significant. Thus, the Nailing group showed better functional outcomes.

Table 4: Functional outcome based on ASES scoring among groups (n = 92)					
S No :	ASES Scoring	Group A (n = 46)	Group D (n = 46)	p value	
1	75 – 90 Excellent	27	13	0.02, in favour of Group A	
2	50 – 74 Good	16	29		
3	25 – 49 Fair	2	2		
4	20 – 24 Poor	1	2		



[Figure 4], shows Mean Union Time, among patients. The Mean Union Time in Group D patients was 8.79 ± 0.439 weeks and the Mean Union Time, in Group A was 6.12 ± 0.286 weeks.

Table 5, shows the difference of Mean Union Time, among groups. There was a difference of Mean Union Time among groups, that Group D had longer Mean Union Time, compared with Group A and the difference was found to be statistically significant. Here again the Nailing group, had outperformed the Plating group.

Table 5: Mean union time among groups (n = 92)					
S No :	Groups	Mean	Standard deviation	Range	p value
1	Group D	8.79	0.43	8.1 – 9.5	0.001, in favour of

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Group A 6.12

0.28

Figure 5: Incidence of complications - Infections

Group D Group A



[Figure 5], shows incidence of complications. 1 patient (2.17%) in Group A developed infection and was treated with parentral antibiotics, which showed good response. 4 patients (8.69%) in Group D, developed infection, which also responded well to parentral antibiotic treatment. There were no patients with, implant failure and restriction of shoulder abduction, reported in either of the two Groups. We wish not to highlight much on this finding because, the lone case of infection in AIILN Group was of open Grade 3C, and in the 4 cases of infection in the DCP group, 3 cases were of open Grade 3C and 1 case was of open Grade 3B. So, the findings may not be reflective of much a statistical significance.

Exchange of larger size nail after re-reaming and fracture site PRP injection was resorted to in 2.17% (n=1) cases, in the Nailing group. Re-operations requiring bone grafting was encountered in 4.34%(n=2) cases, in the plating Group. All cases however, went on to sound healing, in a range of 6 to 8 weeks. Thus with regard to the Non-Union rates, we have not been able to establish the superiority of AIILN over DCP, in this study. In our series of 92 cases, we had 2.17% (n=1), case of latrogenic Radial Nerve Palsy, which recovered with conservative management within 5 weeks. This particular case was in the plating (DCP Group).

Case Illustrations Nailing – (AIILN-Group A)



5.7 - 6.6

Group A

Figure 6:Pre-Op



Figure 7:Immediate Post-Op



Figure 8:6 months Follow-up





Figure 9:Pre-Op

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Figure 10: 6 months Follow-up

DISCUSSION

This retrospective study compared AIILN with DCP, among patient with open Humeral Diaphyseal Fractures and found that AIILN shows better outcomes with respect to Mean Union Time (MUT), and Good Functional Outcomes.

Changulani M et al.^[12]; research in Lucknow, compared DCP and IMN for Diaphyseal Humeral Fractures and found that the average union time was substantially shorter for IMN (P 0.05). Both groups unionization rates were discovered to be comparable. Our study also stated that the mean union time was shorter in AIILN group, compared with DCP. Thus this study, stands in favour of AIILN.

Changulani M et al.^[12]; research, showed that Infection-related complications were shown to be more common with DCP than IMN, although arm shortening (1.5–4 cm) and shoulder mobility restrictions because of nail impingement were found to be more common with IMN than DCP. Our study also stated that DCP has had a higher infection rate compared with AIILN. This makes AIILN a better choice of implant, as per their study. But our finding could not statistically support this argument.

There was no difference between ASES scores among DCP and IMN surgical management based on Changulani M et al.^[12]; research. But our study shows significant difference in ASES scores among both groups. This could be the reason that our study used AIILN and Changulani M et al.^[12] research compared IMN nail with DCP. Thus AIILN was a superior implant with respect to the Functional Outcomes.

Waliet al.^[13]; in their study, found that the ILN group's ASES score was 43.2, whereas the DCP group's score was 44.1, and the results were not significant. This contrast results might be due to their lower sample size and demographic variation.

Sharma P et al.^[14]; research in Chennai, compared Interlocking Nail versus DCP, and found that the functional outcome of AIIN was not significantly better compared with DCP. But our study found that there was indeed a difference among both the



Figure 11:6 months Follow-up

groups and AIILN, showed superior Excellent Scores in Functional Outcome, when compared with the DCP. This variation could be due to population characteristics.

According to the findings of a Meta-Analysis by Ma J et al.^[15]; both IMN and DCP can lead to a fracture union with a similar rate of radial nerve damage and infection. IMN was linked to a higher frequency of implant failure, a higher risk of re-operation, a higher risk of shoulder impingement, more restriction of shoulder motion, a higher risk of intraoperative fracture comminution. The Meta-Analysis concluded that DCP, may be more effective than IMN in treating humeral shaft fractures. But the same research also stated that, the general quality of the GRADE system's evidence was so poor. We too are less confident in this System's Recommendations.

Primary Outcomes

Our finding are consistent with the finding of Honjie Wen et al.^[16]; who in a Meta-Analysis, concluded that Antegrade Intramedullary Nails (AIILN) are superior to Plates, for Humeral Diaphyseal Fractures. Earlier Ouyang et al.^[17]; had suggested that plating may significantly reduce the risk of Restriction of Shoulder Movement, which are encountered in Antegrade Shoulder Nailing cases. According to Ma J et al.^[15]; Ouyang H et al.^[17]; Bhandari M et al.^[18]; and Zhao JG et al.^[19]; there at present exists no clear cut Principal Guidelines on the Modes of Surgical Intervention, especially for Open Humeral Diaphyseal Fractures. Plating, Nailing and MIPPO all have their set of Disadvantages and Advantages. Davies G et al.^[20]; study, done in 2016, showed Humeral MIPPO to be even superior to AIILN, for Humeral Diaphyseal Fractures. Similar was the findings in 2015 by Esmailiejah AA et al.^[21].

Hieneman DJ et al.^[18] in 2010, did not find, any significantly statistically better performance by any one of the implants used for Humeral Diaphyseal Fractures. Therefore, we concur with the findings of Zhao JG et al.^[19] in 2017 that the available suggestion in the Contemporary Literature and the

other Meta- Analytical Studies are of consistently being inconsistent.

As per 2006, publication of Bhandari M et al.^[18]; and 2012 publication of Carroll ES et al.^[22]; the rate of Humeral Open Fracture Non-Unions requiring Re-operations range from 3 to 20 %. For us in the DCP group Non-Union requiring Re-operations and Bone Grafting was at 4.34 % (n=2); which in the next 8 weeks, went on for sound union. In the AIILN group, we encountered Non-Union in 2.17 % (n=1). Thus we are, well within the lowest permissible limits of Non-Union. This case of nail non-union had undergone Humeral re-reaming and a next size nail exchange and fracture site PRP Injection, derived from Autologous Iliac Crest aspirate for 3 weeks, at weekly intervals for 3 times and union was demonstrable after 6 weeks radiologically. Classen FM et al23; in 2015, upon analysing 259 Diaphyseal Humeral Fractures had reported the incidence of Iatrogenic Radial Nerve palsy, to be in the vicinity of 7% (n=3). In our series of 92 cases, we had 2.17 % (n= 1), case of Iatrogenic Radial Nerve Palsy, which recovered with conservative management within 5 weeks. This particular case was in the plating (DCP Group).

Leong G et al24; have, in 2006 trial, had again emphasised that, one must take into consideration intra-operative factors, associated with infection, including operative time, damage to the blood supply and soft tissue stripping. It is obvious, to note here that the Plating procedure, takes a longer time, has more blood loss, has a large incision, a significantly more soft tissue stripping and hence a higher incidence infection rate, can be expected. Our study could not establish any statistically significant outcome in favour of the either Groups.

Chen H et al.^[25]; in 2017, have reported that the plate is superior to IMN, both for the variable of Infection and Union. He however, had used MIPPO, rather than DCP. He had reported a Zero-Infection Rate, in his sample size of 128 patients.

Esmailiejah AA et al.^[21]; similarly suggested in 2015, that the incidence of Non-Union, Infection and Iatrogenic Radial Nerve Injury are lower in the MIPPO, when compared to DCP. This study cannot comment of their outcome, as our study involved use of DCP plate.

Hieneman DJ et al18; in 2012, had remarked that the current literature is continuing to favour the plates over the IMN. Ozan et al26; in 2017 had reported a Non-Union rate of 7 % using a inflatable Intra-Medullary Humeral nail. Our study had used AIILN and our Non-Union rates, for the nailing Group was considerably less at 2.17%; further Ozanet al.^[26]; study was in a considerably lower patient recruits of just 14 cases.

Secondary Outcome

In our secondary outcome, we enlisted the intraoperative time, delay in union time, instances of Re-Operation and Intra-Operative Blood Loss. In all these variables, AIILN, out performed, the DCP. In the instance of AIILN the surgery is achieved by a smaller incision.

Chen H et al.^[25]; has reported in 2017, an average operative time of 60 minutes for plating, Our time for DCP was similar at 52 minutes. Our AIILN operating time was 44 minutes. Shin SJ et al27; in 2012 had reported a mean operative time of 62.7 minutes for MIPPO. The older 2013 Meta Analysis study of Wang X et al.^[28]; had highlighted shoulder impingement and RC, injuries with AIILN. However 10 years down the timeline, the improved nail construct the Surgeon's Experience and Superior Instrumentation, all have contributed to the Humeral Nail System's Refinement and have addressed most of the previous short comings.

Strength and limitations of the present study

The number of subjects is reasonably Good at 92 patients, with equitable distribution, for both the AIILN and the DCP group. Period of follow-up was decent at 2 years.

The limitation is that, the number of patient evaluated in each group individually could have been doubled.

We suggest that, there is a need to perform a larger, ideally 100 in each group, of AIILN, DCP and MIPPO, for Humeral Open Diaphyseal Fractures and the necessity to have a Unified and Correct Scoring System, wherein, the functionality of both the Ipsilateral Shoulder and Elbow Functions are Assessed, meticulously.

While submitting to our limitations, we would be Emphatic in stating that, given our inclusion criteria, the AIILN has outperformed the DCP.

CONCLUSION

Anatomical reduction, solid fixation, and a sufficient blood supply, are the most crucial elements in achieving Sound Bony Healing. Although Internal Fixation with DCP, might produce a better reduction, it also comes with a greater risk of Radial Nerve Injury and Infection, due to the more Extensive Soft Tissue Dissection. Less Soft Tissue Damage and Biological Preservation, are both provided by AIILN's tight and rigid fixation.

We draw the conclusion that Antegrade Locked Intra-Medullary Nailing (AIILN), which has Superior Outcomes, in terms of Union Rate, Mean Union Time (MUT), Functional Outcome and fewer Complications when compared to Plating (DCP), is a useful substitute, for plating in Open Shaft of Humerus Fractures, provided the inclusion and exclusion criterias are adhered to the "Tee".

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Compliance with Ethical standards:

IRB & IEC approval, from Trichy SRM Medical College Hospital and Research Centre, was obtained from the Institutional Research Board.

Written consent was obtained from all the patients or their blood relatives, that the data collected in the form of X-ray Reports and Clinical Data, shall be used for the purpose of ScientificResearch Publications, without exposing in any manner, the privacy of the patient.

Conflict of Interest

The authors declare, that they have no conflict of interest.

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