



An affiliated chapter of INDIAN ORTHOPAEDIC ASSOCIATION | Regd. No. E/13423

GOA e-Bulletin Volume -4 (DIWALI SPECIAL ISSUE 2023)

Year 2023 - 2024

President

Dr. Shrinivas Rao

98795 23753

sylvarao@yahoo.com

Secretary

Dr. Ketan Thakkar

98250 78085

ketznbizz@yahoo.com

President Elect

Dr. Vijay Sata

94277 75057

drvijayedu@yahoo.com

South Zone

Dr. Suketu Dave

94280 25009

drsuketudave@yahoo.com

Saurashtra and Kutchh Zone

Dr. Sanjay Parmar

94267 14467

drskparmar@yahoo.com

Immediate Past President

Dr. Govind Purohit

98252 99873

Dr. Ankit Desai

86929 99397

dr.ankitdesai85@yahoo.com

Dr. Sanjiv Ravisaheb

98250 70367

ravisahebsanjiv@yahoo.com

Treasurer

Dr. Kamlesh Devmurari

94272 77066

drorthokd@yahoo.com

North Zone

Dr. Ajaysinh Devda

99873 21801

ajay2136@yahoo.com

Co-opt members

Dr. Vikas Jain

98241 54927

orthopod_v@yahoo.com

Ahmedabad and Gandhinagar

Dr. Pranav Shah

99798 95596

pranav2510@yahoo.com

Central Zone

Dr. Manoj Mehta

98250 30930

manojmehtah@yahoo.com

Dr. Yogesh Purohit

98796 97744

drygp82@gmail.com

Dr. Bhavik Dalal

94263 57978

drbhavik2006@gmail.com

SECRETARIAT : **Dr. Ketan Thakkar** Akshat Orthopedic Hospital
Opposite Jankalyan Apartments, Near Dr. Sheth Laboratory, Near
Astron Under Bridge, Sardarnagar Main Road, Rajkot - 360 001
+91 98250 78085 | ketznbizz@yahoo.com

Compiled for GOA e-bulletin by
Dr. Ketan Shah 98982 48541
Dr. Pareen Kantesaria 84606 04604
Readers suggestions & feedback on:
Dr. pareen06@gmail.com

FROM THE PRESIDENT'S DESK

Dear Members of the Gujarat Orthopaedic Association,

As the President of the Gujarat Orthopaedic Association, I am thrilled to acknowledge the remarkable success of our eBulletin. Your unwavering support and enthusiasm have been instrumental in making this initiative a great triumph.

With great excitement, I am pleased to announce that this month, we are presenting a special Diwali Issue of our eBulletin. This festive season, may the light of knowledge and camaraderie continue to shine brightly among us all.

I want to express my heartfelt gratitude to each and every one of you for your active participation and valuable contributions. It's your dedication that propels our association forward.

Wishing you and your loved ones a joyous and prosperous Diwali. May this special occasion bring happiness, health, and success into your lives.

Warm regards,

Shrinivas Rao
President, Gujarat Orthopaedic Association

FROM THE DESK OF SECRETARY

Diwali is the time of lights, colours and sweets. Diwali is the festival of Boom boom , bonhomie and bonuses. And bulletins! Special Diwali issue. The GOA e-bulletins have been super hits like SRK's movies.

It has been rollicking rollercoaster of academics with myriad of review articles, interesting case presentations, innovative techniques and scintillating scientific stuff. Our trusted and gallant general Ganjwala sir came up with an amazing spectrum of educational inputs. His coordination, his compilation and his commitment are commendable. Erudite and efficient.

We thank all the contributors for their exemplary work as also for their dedication to GOA. Dr. Ketan Shah and Dr. Pareen Kantesaria have been the workhorses who have shouldered tremendous responsibilities of publishing and printing the bulletins punctually and meticulously.

We have 2 upcoming mega academic events in the span of a fortnight. On 26th November, at Rajkot, we have an IOA- GOA collaborative seminar- workshop on HTO. On 10th December at Ahmedabad, there is a novel seminar on Pathological fractures in Children, Adults and Elderlies under the auspices of GOA, AOS and IMSOS. We cordially invite all to enjoy the carnivals of knowledge.

We are also keen to meet you all in person at the soon forthcoming GOACON at Bhavnagar where the organising committee is all geared to make it a marvellous magnum opus. We earnestly seek your presence at GOACON Bhavnagar on 9th- 10th February, 2024.

We wish all our brethren and their families, a very happy Diwali and a prosperous Gujarati New Year as we embark upon this special bulletin of 'Yeh dil maange more' !

Love and joy
Dr. Ketan Thakkar
Secretary GOA

GUEST EDITOR'S MESSAGE

We are happy to present the Diwali issue of GOA eBulletin. For this special issue, we adopted a different method for selecting the articles. Unlike our routine issues which are mainly based on the zones of the Gujarat Orthopedic Association, this time we selected a few topics that are relevant to our practice. After selecting the topics, we invited experts from outside Gujarat to write the articles covering the current concepts on the topic. We anticipate that these articles will help you in your day-to-day practice to provide evidence-based care to the patients.

My sincere gratitude to the GOA team for asking me to be the guest editor of this issue.

Best wishes for the festive seasons.

Dhiren Ganjwala

Guest editor

FLATFOOT

Avoiding unwarranted, ineffective, and irrational treatment

Prof Benjamin Joseph
Prof Emeritus, Dept of Ped Orthopedics,
Manipal Academy of Health Education
Kasturba Medical College, Manipal, India 576104
Email: bjoephortho@yahoo.co.in

What is flatfoot?

When the medial longitudinal arch of the foot has not formed or has collapsed, it is referred to as flatfoot. Virtually all normal newborn infants have poorly formed arches; the arch develops over the course of five or six years. This implies that flatfoot is normal in most young children.

Types of flatfoot

Flatfeet may either be mobile (flexible) or rigid; this distinction is vitally important as mobile flatfeet are physiologic and painless in most instances, while rigid flatfeet are often painful.

To distinguish between mobile and rigid flatfeet, ask the person to stand on tip-toe. Standing on tip-toe will restore the arch if the flatfoot is mobile while the arch will not be restored if the flatfoot is rigid. Over 90% of flatfeet are mobile and well over 90% of mobile flatfeet are completely asymptomatic.

Is there a need to change the general perception regarding treatment of flatfeet?

It had been a long-held view in the West that that flatfoot in children may be corrected using shoe modifications, though this has never been scientifically proven. Clinicians in India also followed this traditional Western teaching and began to recommend shoes with modifications of their soles to “cure” flatfoot. Is this approach rational?

The author had observed that the frequency of children with flatfoot in his outpatient clinic in India was exceedingly low when compared to his experience in the United Kingdom. He assumed that the fact that several Indian children were unshod may have a bearing on this observation.

He undertook two cross-sectional surveys for flatfoot to test a hypothesis that there is an association between shoe wearing and the prevalence of flatfoot.^{1, 2} Among 2300 school-going children who were screened, the prevalence of flatfoot was lowest in children who never wore shoes, higher in those who wore slippers and sandals and highest in children who wore closed-toe shoes.¹ In a second survey of 1846 adults, it was noted that the prevalence of flatfoot was highest in those who had begun using footwear in early childhood and lowest in those who began wearing any form of footwear after the age of 16 years.² These two studies confirmed that there was a definite age-related association between shoe-wearing and flatfoot. The observations suggested that early shoe-wearing was detrimental to the development of the arch of the foot.

In the light of the results of the two studies, the rationale of prescribing any form of footwear for the correction of flatfeet in young children is questionable. Furthermore, there is a body of evidence that indicates that orthoses and shoe modifications (arch supports, heel cups, crooked and elongated heels, and rigid shoe inserts) do not change the natural history of flatfoot.^{3 - 7}

Is flatfoot harmful?

It has been assumed that flatfoot functions less efficiently than a foot with a well-formed arch. This unsubstantiated impression led to the practice of rejecting potential recruits to the armed forces and the police. This assumption has been questioned 7, 8, 9 and sections of a report that appeared in the New York Times in 1990 is quoted here.¹⁰

"The Maligned Flat Foot: Some See an Advantage"

"Ballet masters shun dancers with low arches and in slang "flat-footed" is synonymous with clumsy. In World War II, the military turned down thousands of recruits because they had flat feet.

*For years, the flat-footed have been warned that their lives would be plagued with pain and injury and doctors have tried using surgery and braces to correct the "deformity." But after decades of derision, **new research is showing that flat feet are perfectly functional and may even be an advantage in sports.***

In a 1989 study of more than 300 Army infantry trainees at Fort Benning Ga., those with flat feet had far fewer training injuries than recruits with normal or high insteps. In fact, trainees with high arches suffered twice as many injuries, including sprains and stress fractures, as their flat-footed comrades.

"Much of what we've believed about flat feet is mythology," said Dr. Bruce H. Jones of the Army Institute of Environmental Medicine in Natick, Mass., and one of the study's authors. "I've seen drill sergeants with arches as convex as the bottoms of rocking chairs, who are active and successful."

"We've all been brought up on grandmother's warning that flat feet are bad, so we'd better correct them," said Dr. Francesca Thompson, chief of the orthopedic adult foot clinic at Roosevelt Hospital in New York. "As we've become more scientific, we've begun to ask, 'why?'"

Does flatfoot need to be treated?

Asymptomatic mobile flatfeet do not need any treatment. In other words, over 90% of children with flatfeet do not need treatment. Encouraging young children to play with bare feet may be beneficial. Treatment is only justified if there is pain in the foot. Treatment should thus be reserved for rigid flatfeet and the rare symptomatic mobile flatfoot.

1. Rao UB, Joseph B. Influence of footwear on the prevalence of flatfoot. A survey of 2300 children. Journal of Bone & Joint Surgery 1992; 74 - B: 525 - 7.
2. Sachithanandam V, Joseph B. Influence of footwear on the prevalence of flatfoot. A survey of 1846 skeletally mature persons. Journal of Bone & Joint Surgery 1995; 77 - B: 254 - 7.
3. Wenger, D R; Mauldin, D; Speck, G; Morgan, D; Lieber, R L. Corrective shoes and inserts as treatment for flexible flatfoot in infants and children. The Journal of Bone & Joint Surgery 1989; 71(6): 800-10.
4. Oerlemans LNT, Peeters CMM, Munnik-Hagewoud R, Nijholt IM, Witlox A, Verheyen CCPM. Foot orthoses for flexible flatfeet in children and adults: a systematic review and meta-analysis of patient-reported outcomes. BMC Musculoskelet Disord. 2023 Jan 7;24(1):16. doi: 10.1186/s12891-022-06044-8. PMID: 36611153; PMCID: PMC9825043.
5. Evans AM, Rome K. A Cochrane review of the evidence for non-surgical interventions for flexible pediatric flat feet. Eur J Phys Rehabil Med. 2011 Mar;47(1):69-89. PMID: 21448121.

6. Jane MacKenzie A, Rome K, Evans AM. The efficacy of nonsurgical interventions for pediatric flexible flat foot: a critical review. *J Pediatr Orthop*. 2012 Dec;32(8):830-4. doi: 10.1097/BPO.0b013e3182648c95. PMID: 23147627.
7. Cowan DN, Jones BH, Robinson JR. Foot morphologic characteristics and risk of exercise-related injury. *Arch Fam Med*. 1993 Jul;2(7):773-7. doi: 10.1001/archfami.2.7.773. PMID: 7906597.
8. Michelson JD, Durant DM, McFarland E. The injury risk associated with pes planus in athletes. *Foot Ankle Int*. 2002 Jul;23(7):629-33. doi: 10.1177/107110070202300708. Erratum in: *Foot Ankle Int*. 2003 Mar;24(3):216. PMID: 12146774.
9. Esterman A, Pilotto L. Foot shape and its effect on functioning in Royal Australian Air Force recruits. Part 1: Prospective cohort study. *Mil Med*. 2005 Jul;170(7):623-8. doi: 10.7205/milmed.170.7.623. PMID: 16130646.
10. Rosenthal E. The maligned flatfoot: Some see an advantage. *New York Times* Nov.22, 1990, Section B, Page 18.

Current controversies in the management of pink pulseless hand following supracondylar fracture of the humerus

K. Venkatadass, Naresh Sundramurthi

Abstract:

Supracondylar fractures are common pediatric orthopedic injuries, and their management, particularly when associated with a pink pulseless hand, has been a subject of ongoing controversy. While these fractures usually present with a variety of vascular and neurological challenges, the approach to treatment has evolved over the years, with debates surrounding the optimal management strategy. This review article explores the current controversies and emerging perspectives in managing pink pulseless hands in supracondylar fractures, providing insights into the diagnostic criteria and treatment options for this challenging scenario.

Introduction:

Supracondylar fractures are one of the most common fractures in the paediatric population, accounting for approximately 60% of all paediatric elbow fractures. Approximately 10-15% of these fractures are found associated with vascular complications. The standard treatment of these fractures with associated vascular compromise involves emergency closed reduction and percutaneous pinning. In about 80% of these, the pulse would return back after closed reduction and pinning. In a subset of patients, the hand appears pink, well perfused, but remains pulseless which is called as the 'pink pulseless hand'. A dilemma arises regarding whether immediate vascular exploration should be pursued or if a more cautious observation approach is warranted. The management of this subgroup has long been a subject of debate and evolving understanding. However, when the patient's hand remains pale, pulseless and lacks perfusion despite these initial measures, vascular exploration is necessary with or without vascular repair.

Assessment of a pulseless hand:

The absence of a clinically palpable radial artery pulsation is the main criteria to establish the diagnosis of a supracondylar fracture with a vascular compromise. Although this method is widely accepted and practical, it does have limitations as it is subjective and can be challenging in a child with a swollen elbow and forearm. The absence of a palpable pulse aids in distinguishing cases with compromised vascularity from routine supracondylar fractures, necessitating a completely different and urgent treatment approach for these fractures.

The lack of pulse does not signify an absence of perfusion and, as a result, it is imperative to record the perfusion of the hand in these individuals. The evaluation of perfusion encompasses both subjective and objective techniques.

The subjective assessment of perfusion includes the colour, capillary refill and palpable feel of the hand whether it's cold or warm. The objective assessment of perfusion includes the following: **a) Presence of radial or ulnar artery doppler signals in either hand held doppler or a conventional doppler ultrasound and b) Pulse oximeter oxygen saturation measurement with Spo2 and waveforms.**

Soh et al in their study of 26 pulseless SCH fractures, found that 22 patients had good pulse oximeter

waveforms, while four patient had poor pulse oximeter waveforms. Subsequently, these four patients underwent brachial artery exploration following fracture fixation . Badkoobehi et al stated that in SCH fractures with vascular compromise, children should be observed inpatient for 24 – 48 hours following fracture stabilization. If perfusion is comprised, an emergency return to the operation room for vascular exploration is indicated .

A pulseless supracondylar fracture can have co-existing nerve injury. This needs to be documented and there are studies which favour exploration when there is an associated median nerve injury. Weller et al shown higher incidence of nerve involvement in SCH fractures without pulse comparing the fractures with intact pulse . Mangat et al in his study of 19 pink perfused SCH fractures concluded that vascular exploration is recommended when perfused hand in a SCH fracture present with coexisting AIN or median nerve, as they appear to be strong predictor of entrapment of vessel and nerve at fracture site .

In a study conducted by Scannell et al, the authors studied the correlation between existence of the median or anterior interosseous nerve and the patency of the brachial artery during long-term follow-up in a cohort of twenty patients. It was found that median nerve palsy exhibited a strong predictive capability for brachial artery occlusion, whereas anterior interosseous nerve palsy did not demonstrate the same predictive capacity for brachial artery occlusion.

Studies recommending exploration:

Mangat et al in their study of 19 pink perfused SCH fracture patients, 8 patients had undergone vascular exploration, documented entrapment of the brachial artery with tethering at the fracture site(6). Delayed exploration was done in four patients of which three patients had median and/or AIN palsy at presentation. They recommended early vascular exploration of a Gartland Type III SCH fractures in patients who present with coexisting AIN or median nerve palsy.

Korompilias et al recommended vascular exploration for the restoration of brachial artery patency, even in the presence of a viable well-perfused hand after an attempt at closed reduction(8).

White et al in their study concluded absent pulse with perfused hand is an indicator of arterial injury in 70% of patients(9). Hence, he advocated detailed vascular evaluation and exploration with arterial repair in selected cases as it may limit chances of late complication, and also patency rates of revascularization procedures are quite satisfactory. They also advocated use of ultrasound colour Doppler study as supplemental diagnostic tool in post reduction and pinning for determining severity of arterial injury.

Blakey et al in their study of 26 children, found that three patients with initial successful vascular exploration had a return of pulse. Twenty three patients had some evidence of ischemic contracture following initial management. Vascular exploration was performed in 21 patients, out of which 12 patient had severe vessel compression due to dense scar tissue and in 9 patients, the vessel was trapped within the fracture site. Pulse returned in all cases after vascular exploration(10).

Studies recommending observation:

Choi et al in their study of 33 SCH fractures with an absent pulse, found that out of 29 cases of well

perfused hands, the return of pulse was seen in 11 patients with closed reduction and pinning alone(11). Ramesh et al in their study of 15 cases of pink pulseless hand found the return of pulse in 8 patients immediately, while the pulse returned late in remaining cases at 3-6 weeks of final follow up. They concluded saying vascular exploration needed only when there is persistent severe pain and deteriorating neurological function in post fracture reduction in pink pulseless hand(12). Louahem et al, in their study with 68 SCH fractures with neurovascular injury, observed return of pulse in 42 patients who underwent closed reduction and pinning(13).

Scannell et al showed 20 patients with a perfused, pulseless supracondylar humerus fractures treated with closed reduction and percutaneous pinning, all children demonstrated palpable pulse at final follow up, though five of the twenty patient had an occluded brachial artery. No growth abnormality with excellent functional outcomes were recorded(7).

Sabharwal et al found increased asymptomatic re-occlusion and residual stenosis of brachial artery in 5 out of the 12 patients who underwent revascularization procedures for treating vascular insult. They employed Doppler ultrasound and Magnetic resonance arteriography for identifying these vascular insult. They also advocated period of observation with frequent vascular checks should be followed before more invasive correction of this problem is contemplated(14).

In a retrospective analysis of 39 pink pulseless hands, Heyer et al in 2022 concluded that none of the patients needed unexpected return to operating room or developed compartment syndrome or Volkmans ischemic contracture (15).

Recommendations:

The management of a patient with an absent pulse following closed reduction and percutaneous pinning of a supracondylar fracture is still controversial and challenging. Labelling a patient as 'pink pulseless hand' based on subjective assessment and making a decision of close observation based on the appearance of hand and capillary refill is not backed up by strong evidence. It is evident from the literature that an objective evaluation of limb perfusion is imperative for clinical decision-making. The objective assessment includes hand-held/ conventional Doppler signals of radial and ulnar arteries and pulse oximeter saturation along with waveforms. Any patient with doubtful perfusion with no doppler signals or less SpO₂ with irregular wave forms needs vascular exploration to establish the perfusion of the limb. It has been our experience that most of the times, the brachial artery is kinked or compressed by a fibrous strand or entrapped at the fracture site. Significant vascular injury needing arterial repair or anastomosis is extremely rare.

Figure:

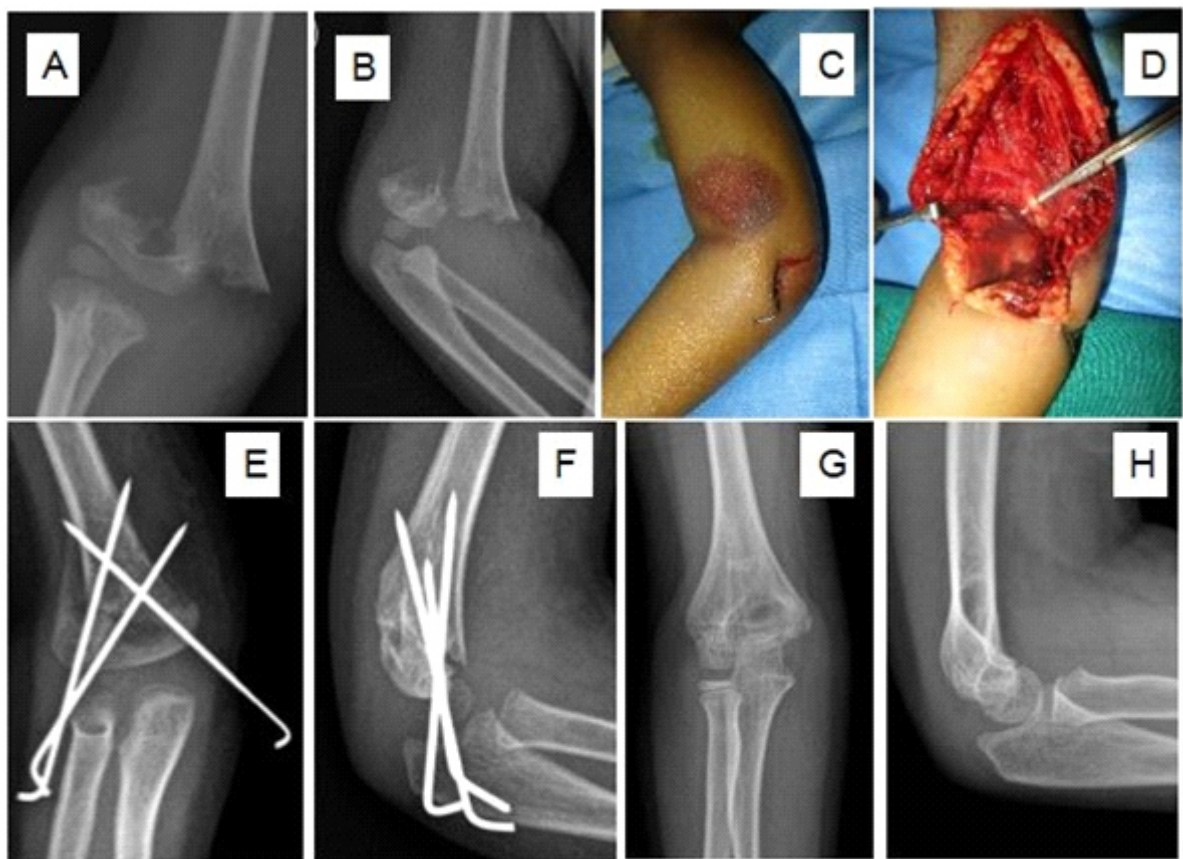
A,B: Pre-operative AP & lateral radiographs of an 4 year old boy with grossly displaced Type III supracondylar fracture who presented with absent pulse

C – Clinical photograph after closed reduction and percutaneous pinning showing ecchymosis in cubital fossa

D – Intra-operative picture showing brachial artery entrapped at the fracture site

E&F – Post-operative AP & lateral radiographs showing the fracture reduced and stabilised with three K wires

G&H – Follow-up AP & lateral radiographs at 4 yrs following injury showing complete healing and remodelling of the fracture without any deformity



References:

- 1.Farnsworth CL, Silva PD, Mubarak SJ. Etiology of supracondylar humerus fractures. J Pediatr Orthop. 1998;18(1):3842.
- 2.Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. J Bone Joint Surg Am. 2008 May;90(5):112132.

- 3.Soh RCC, Tawng DK, Mahadev A. Pulse oximetry for the diagnosis and prediction for surgical exploration in the pulseless perfused hand as a result of supracondylar fractures of the distal humerus. Clin Orthop Surg. 2013 Mar;5(1):7481.
- 4.Badkoobehi H, Choi PD, Bae DS, Skaggs DL. Management of the pulseless pediatric supracondylar humeral fracture. J Bone Joint Surg Am. 2015 Jun 3;97(11):93743.
- 5.Weller A, Garg S, Larson AN, Fletcher ND, Schiller JR, Kwon M, et al. Management of the pediatric pulseless supracondylar humeral fracture: is vascular exploration necessary? J Bone Joint Surg Am. 2013 Nov 6;95(21):190612.
- 6.Mangat KS, Martin AG, Bache CE. The “pulseless pink” hand after supracondylar fracture of the humerus in children: the predictive value of nerve palsy. J Bone Joint Surg Br. 2009 Nov;91(11):15215.
- 7.Scannell BP, Jackson JB, Bray C, Roush TS, Brighton BK, Frick SL. The perfused, pulseless supracondylar humeral fracture: intermediate-term follow-up of vascular status and function. J Bone Joint Surg Am. 2013 Nov 6;95(21):19139.
- 8.Korompilias AV, Lykissas MG, Mitsionis GI, Kontogeorgakos VA, Manoudis G, Beris AE. Treatment of pink pulseless hand following supracondylar fractures of the humerus in children. International Orthopaedics. 2009 Feb;33(1):23741.
- 9.White L, Mehlman CT, Crawford AH. Perfused, pulseless, and puzzling: a systematic review of vascular injuries in pediatric supracondylar humerus fractures and results of a POSNA questionnaire. J Pediatr Orthop. 2010 Jun;30(4):32835.
- 10.Blakey CM, Biant LC, Birch R. Ischaemia and the pink, pulseless hand complicating supracondylar fractures of the humerus in childhood: long-term follow-up. J Bone Joint Surg Br. 2009 Nov;91(11):148792.
- 11.Choi PD, Melikian R, Skaggs DL. Risk Factors for Vascular Repair and Compartment Syndrome in the Pulseless Supracondylar Humerus Fracture in Children. Journal of Pediatric Orthopaedics. 2010 Jan;30(1):506.
- 12.Ramesh P, Avadhani A, Shetty AP, Dheenadhayalan J, Rajasekaran S. Management of acute “pink pulseless” hand in pediatric supracondylar fractures of the humerus. J Pediatr Orthop B. 2011 May;20(3):1248.
- 13.Louahem DM, Nebunescu A, Canavese F, Dimeglio A. Neurovascular complications and severe displacement in supracondylar humerus fractures in children: defensive or offensive strategy? J Pediatr Orthop B. 2006 Jan;15(1):517.
- 14.Sabharwal S, Tredwell SJ, Beauchamp RD, Mackenzie WG, Jakubec DM, Cairns R, et al. Management of pulseless pink hand in pediatric supracondylar fractures of humerus. J Pediatr Orthop. 1997;17(3):30310.
- 15.Heyer JH, Mitchell SL, Garcia S, Flynn JM, Anari JB. A Modern Day Timeline for In-Hospital Monitoring in Perfused, Pulseless Pediatric Supracondylar Humerus Fractures. Journal of Pediatric Orthopaedics. 2022 Dec;42(10):589.

Plantar Fascitis

Dr. Rajeev Vohra
MS, DNB, MNAMS
Consultant Foot and Ankle Surgeon, Amandeep Hospital Amritsar,
Email: vohra.r2@rediffmail.com

About 10% of the population suffers from inferior heel pain and symptoms are mostly attributed to “Plantar Fascitis (PF)”, which of course is the most common pathology, but it is one of the potential causes of inferior heel pain. Awareness of the other pathologies responsible for inferior heel pain and getting the right diagnosis are essential to provide effective treatment. Apart from PF the calcaneal bone pathologies, neuritis of the posterior tibial nerve and its terminal branches, and soft tissue disorders like fat pad atrophy, fat pad bruising and soft tissue tumours of the heel region can cause inferior heel pain.

Plantar fascia is thickened fibrous aponeurosis originating from the plantar tuberosity of the calcaneus and connects the calcaneus to the toes and creates the arch of the foot. Proximally the plantar fascia is continuous with gastro-soleus complex. The disorders affecting plantar fascia include plantar fasciitis (PF), plantar fascia tears, plantar fascia enthesopathy and perifascial oedema.

PF is considered an overuse injury, with repetitive microtrauma and damage to the plantar fascia occurring at a rate that exceeds the body's capacity to heal. Increased load may be the result of obesity, prolonged standing, or overactivity by a fit individual. Other extrinsic factors that have been proposed to cause plantar fasciitis include wearing improper or excessively worn shoes, running on unyielding surfaces and training errors during sports activities, spending most of the workday on the feet, and an increased percentage of time spent walking at work.

The incidence of PF peaks between 40 and 60 years of age, and diagnosis in most cases is based only on clinical examination. Typically, patients present with pain on the first few steps in the morning (start-up pain) and after periods of inactivity. The “start-up” pain is thought to be due to stretching of tightened plantar fascia and Achilles tendon whilst asleep when the foot is in an equinus position. Pain due to PF generally subsides to some degree with ambulation and mobilization. During a daily routine, prolonged standing particularly on hard surfaces and the use of footwear with hard soles aggravates the symptoms. As the disease progresses pain will also be noted at rest owing to the tissue inflammation that results from repetitive tissue stress during daily activities. It is important to elucidate the site, character, severity, time, and duration of the pain to reach the correct diagnosis. Acute pain may represent plantar fascial tear which may be associated with bruising and swelling, and an inability to toe-off, run or possibly even stand.

The treatment for a plantar fascia tear is different from PF and includes immobilization in a plaster cast until symptoms subside, followed by a period in a stiff-soled boot or shoe. Bilateral involvement and pain may be due to plantar fascia enthesopathy associated with medical conditions like ankylosing spondylitis, psoriatic arthritis, reactive arthritis and Reiter's syndrome. It requires a careful systemic review to identify ophthalmic, dermatological or genitourinary symptoms and a referral to a rheumatologist for appropriate management. The central and proximal location of the pain may be due to fat pad bruising atrophy or some soft tissue neoplasm. Night pain is suggestive of calcaneal tumour or osteomyelitis. Neuritic symptoms like tingling, paraesthesia, and numbness point toward the involvement of the posterior tibial nerve or its branches.

During physical examination, the localizing point of maximum tenderness is extremely helpful in diagnosing PF and ruling out other causes of inferior plantar pain (**Figure 1**).

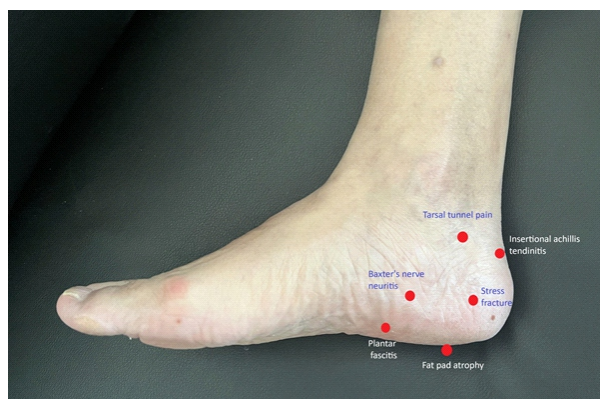


Figure 1 Tender points and relationship to clinical diagnosis

IN PF pain is mostly located at the plantar medial tubercle of calcaneus, and occasionally may extend along the course of plantar fascia into the central arch. Pain is exacerbated by the Jack test to dorsiflex the hallux, thus tightening the plantar fascia via the windlass mechanism. Positive calcaneus squeeze test, which is significant pain on medial and lateral compression over the posterior inferior body of the calcaneus is suggestive of periostitis or stress fracture of the calcaneus. Pain with midfoot, hindfoot, and ankle range of motion is generally absent. Silfverskiöld test should be performed to assess gastrocnemius-soleus tightness. Although PF is a clinical diagnosis, plain radiographs are often done to rule out other causes of inferior heel pain. The presence of heel spur does not signify PF, as heel spur is present in up to 25% of the population and plantar fascia is not attached to heel spur. Both MRI and Ultrasonography have been used to assess the thickness and tears of the plantar fascia. In the majority of cases, fascial thickening is seen on MRI but no significant oedema is present. Florid peri-fascial oedema suggests an inflammatory process and requires oral non-steroidal anti-inflammatory medication and/or an ultrasound-guided steroid injection above the fascia. This should be followed by a period of rest.

Treatment

There is strong evidence that PF is often self-limiting, but may take up to 18 months to resolve, and therefore treatment is essential to provide early relief. The first line of treatment is the use of oral analgesics and anti-inflammatory drugs, activity modification, removing the precipitating causes, shoe wear modification, and exercises. Heel cushions can decrease pain by reducing direct impact on the heel, and prefabricated or custom orthoses may be helpful in over-pronated feet. Night splints can be used to prevent the ankle from adopting an equinus position overnight, thus preventing tightness of the plantar fascia. Exercises are directed to stretch the plantar fascia and gastro-soleus complex and strengthening the intrinsic musculature of the foot-.

(https://www.youtube.com/watch?v=7TjJD_unCtc&t=3s).

A contrast bath is also helpful when used along with the above-mentioned modalities. It produces temperature fluctuations which help in the creation of a local pump to improve blood circulation. Iontophoresis is another physical therapy technique used for the treatment of PF. It uses electrical stimulation to help administer medication into your body through the skin.

If the patient doesn't respond to the above treatment extracorporeal shock wave therapy (ESWT) or percutaneous injections are used as the second line of treatment. A variety of injection techniques (e.g., steroids, platelet-rich plasma, amniotic tissue, botulinum toxin, needling, and prolotherapy), have been recommended, but it is still not clear how these will compare with each other and other treatment protocols. Steroid injection is commonly used for the treatment of PF, but it may reduce pain up to one month but not subsequently. Single ultrasound-guided dexamethasone injection is effective and safe,

but it is not clear whether it can provide long-term relief. Ultrasound helps to place the injection near the insertion of the plantar fascia into the calcaneus, and not within the fascia itself. While injecting steroids, complications like plantar fascia rupture, fat pad atrophy, and post-injection flare must be kept in mind. ESWT involves the delivery of high or low energy by radial or focussed shock waves to treat PF. High energy typically involves one treatment under general anaesthesia. Low-energy treatment is tolerable awake, usually over several weeks. Patients not responding to ESWT or injections may be subjected to radiofrequency ablation which is done using a micro-debrider device connected to a generator set to perform micro-tenotomy. Plantar fascia is accessed percutaneously with 2mm K-wires and micro-tenotomy is performed in a grid-like pattern.

More than 90% of cases of PF will heal with non-operative measures. Surgery should be delayed until at least 12-18 months following the onset of symptoms and if all non-operative measures have failed. In overweight individuals, weight loss should be achieved before considering surgery. Surgical strategies include plantar fasciotomy, lengthening the gastrocnemius-soleus complex or both these techniques. Fasciotomy can be accomplished through percutaneous, open and endoscopic techniques. A maximum of 50% of the plantar fascia is suggested since the risk of medial arch collapse and lateral column overload increases beyond this value.

Gastrocnemius release is a safe and effective option for chronic, refractory plantar fasciitis in patients with gastro-soleus complex tightness and decreased dorsiflexion at the ankle. Release of the medial head of gastrocnemius can be done proximally in the popliteal fossa or distally at the myotendinous junction. About 81 to 95% satisfaction rates have been reported with these procedures.

In patients with neuritic symptoms or recurrent symptoms or in failed surgery, a more extensive procedure is considered. It includes plantar fascia release, exploration and release of the tibial nerve and its branches, and excision of spur if present.

Conclusions

PF presents as inferior heel pain which is typically startup pain in the morning and generally subsides to some degree with ambulation and mobilization. As it is a clinical diagnosis, other causes of the inferior heel pain need to be ruled out for correct treatment. Most of the patients respond to conservative treatment but selective patients may require more invasive therapy, however, it is not clear which patients will most benefit from surgical treatment and what the best method of treatment is.

References

1. Schneider HP, Baca JM, Carpenter BB, et al. ACFAS Clinical Consensus Statement American College of Foot and Ankle Surgeons Clinical Consensus Statement: Diagnosis and Treatment of Adult Acquired Infracalcaneal Heel Pain. *The Journal of Foot & Ankle Surgery* 57 (2018) 370–381
2. Rose B, Singh D. Inferior heel pain. *Orthopaedic and trauma* 2019; 34:1.
3. Boakye L, Chambers MC, Carney D, et al. Management atic Plantar Fasciitis. *Oper Tech Orthop* 2018; 28:73-78.

Management Options For Resistant Lateral Epicondylitis

Dr. Warid Altaf

Senior Consultant Dept. of Hand & Upper Limb Surgery

Sancheti Advanced Ortho-care Hospital Pune.

Email: waridaltaf@gmail.com

Abstract : Lateral epicondylitis is a condition in which there is an inflammation over the common extensor origin of the elbow joint. It is a significant source of pain and dysfunction, resulting from repeated gripping of wrist or wrist extension or radial deviation of the wrist & forearm supination. Although the treatment of lateral epicondylitis is very well established in literature, however, we still see many cases of resistant lateral epicondylitis which are very difficult to treat. The treatment usually includes non-steroidal, anti-inflammatory drugs, physical therapy, shockwave therapy, injection with corticosteroid or biologics and followed by intralesional injections have also been tried with excellent results for the refractory cases. The use of Platelet rich plasma (PRP) has also been established in various studies with reasonably good results, the data demonstrate that NSAIDs physiotherapy, bracing and shockwave therapy provide a good results. Biologic such as PRP and autologous whole blood injections may be superior to steroid injections in long-term. Resistant cases can be treated with surgical options which include open arthroscopic and percutaneous techniques. So in this article we are going to discuss the pathophysiology alongside the treatment, options of resistant lateral epicondylitis.

Keywords: Lateral Epicondylitis, plate rich plasma, shockwave therapy, tennis elbow, surgery.

Introduction:

Tennis elbow or lateral epicondylitis [LE] affects 1 to 3% of the general population every year [1]. If we go through the data of western literature it affects around 1 million people in the United States annually [2]. Unfortunately we don't have the exact data in our country but if we compare it to the Western data, the number in India will be staggering. Despite of being a very common condition which we see in our day to day practice, there is no single gold standard solution in terms of treatment [3]. As a result of this, we see many cases of resistant lateral epicondylitis which are not getting relieved with the standard treatment [4]. Lateral epicondylitis also produces a heavy social economic burden, resulting from lost workdays and may cause and enable it to work for several weeks in some of the patients.

Epidemiology & Pathophysiology:

Lateral epicondylitis mostly affects the adults which are in their 3rd to 5th decade of life [5]. It has been shown that the incidence of lateral epicondylitis is usually also associated with the inflammatory conditions such as the de-quervain's tenosynovitis, rotator, cuff disease, Carpal Tunnel Syndrome, use of corticosteroids, smokers and low socio-economic group of people [6].

There is a well documented evidence that lateral epicondylitis is commonly associated with over use injury. Strain from activities involving repetitive gripping or repeated wrist extension movements along with forearm supination movements. The tendon which is most commonly supposed to be involved is the ECRB Tendon, which has a tendinous origin from the distal part of the lateral humeral condyle. The repetitive movements of the wrist cause the micro tearing of the origin of ECRB, which starts the inflammation in that area, and if no remedy is taken at that time, it may lead to a chronic condition known as lateral epicondylitis [7].

The term tennis elbow is actually a misnomer as only 5 to 10% of patients who are professional tennis players suffer from this condition. It has been rather noticed that it is more commonly seen in various occupations like those involved in plumbing, painting, driving two-wheelers for long duration. The most likely pathogenesis of tennis elbow is believed to be a new angio-fibroblastic hyperplasia, which is a

degenerative process in which the tendons manifest more fibroblastic-activity, Vascular hyperplasia and collagen fiber deposition.

Rather than an inflammatory response, it is predicted to be an aborted healing response to repeated micro trauma.

Resistant tennis elbow is a condition which is not uncommon. It is reserved for the group of people who have been taking conventional treatment for tennis elbow with no or less recovery and frequent recurrences. Patients may present with a sensation of burning over the humeral insertion of common extensor origin tendon and other symptoms include loss of grip strength, pain during the daily activities, mostly while grasping objects, turning the wrist while opening doors, shaking hands and also while making a tight fist. Most of the cases of tennis elbow are self-limiting and the symptoms are resolved usually during one year, but however there are patients who have ongoing symptoms for more than a year, despite medical and physical therapy and they mostly qualify into the condition called resistant lateral epicondylitis [8]. The people at risk of developing these or manual laborer's with dominant arm involvement, longer duration of symptoms with high baseline pain levels and poor coping mechanisms are associated with bad outcomes. 3 to 11% of these patients may require surgical intervention as per various studies [9]. Knutsen et al found in a multicentric study that history of prior injection, prior orthopaedic surgery, workers' compensation claim, presence of radial tunnel syndrome, and symptoms greater than 1 year were predictors of surgical treatment [10].

Clinical Examination & Diagnosis:

Patients usually complain of pain over the outer aspect of elbow which more often radiates down along the forearm and sometimes up along the outer aspect of the arm. The pain is aggravated by grasping objects strongly especially while the wrist is extended against the resistance like twisting towels[11]. The degree of pain may range from mild to severe and also in some cases there may be weakness of the grip along with difficulty in lifting objects[12]. The elbow motion is usually preserved even in very severe cases[13].

Initial Treatment:The initial treatment of lateral epicondylitis is always non operative. It includes Rest, Orthotic braces, NSAIDS, Physical therapy, shockwave therapy & intra-lesional steroid or Platelet rich Plasma (PRP) injections. Newer modalities like stem cell therapy & Autologous whole blood injections (ABI's) are being increasingly utilised for the treatment of resistant lateral epicondylitis [14].

Physiotherapy: Various physiotherapy modalities are recommended for the treatment of Lateral epicondylitis. Traditional treatment options include electrotherapeutic and non-electrotherapeutic modalities, aiming for improving function and reducing pain by stretching and strengthening the affected wrist extensors [15]. Recently, eccentric exercise (EE) has gradually been a first-line conservative treatment for Lateral epicondylitis. EE is executed via stretching the musculotendinous unit with an applied load. Clinical trials have demonstrated that the EE has superior efficacy in the treatment of LE, in comparison with therapeutic ultrasound, bracing, [16], and a combination of multiple interventions.

Extracorporeal Shock-Wave Therapy: Extracorporeal shock-wave therapy (ESWT) is one of the commonly used physical therapy modalities for treating LE, in spite of conflicting results in the available literature. The mechanism of ESWT has not been completely clarified, possibly including direct stimulation of healing, neovascularization, direct suppressive effects on nociceptors, and a hyperstimulation mechanism blocking the gate control [17]. ESWT may not reverse the pathology of LE but improve the symptoms of LE. ESWT is not appropriate for acute LE but is recommended when symptoms persist for more than 6 months or when other conservative treatments fail.

Autologous Blood Injection (ABI) : Local ABI has been proved effective and widely used for treatment of LE. There are two hypotheses for the mechanism of ABI. On the one hand, ABI works by initiating the inflammatory response around the affected tendon, which may result in cellular and humoral mediators to induce a healing cascade [18]. In addition, it should be noted that ABI has high risks of injection site pain and skin reaction. Accordingly, its indications should restrict to those recalcitrant cases when other

modalities of treatment are less effective.

Platelet-Rich Plasma (PRP) Injection: PRP has gained popularity in recent years in the treatment for LE. The exact mechanisms of PRP remain unknown. There are theories attributed to platelets releasing high concentrations of platelet-derived growth factors enhancing wound healing, bone healing, and tendon healing. However, available studies have reported conflicting results, which make it difficult to draw clear conclusions on PRP for LE. The latest systematic review manifested that PRP injection has no obvious effects on the treatment of chronic LE [19]. Several studies have shown that PRP does not provide significant benefits over corticosteroids, ABL, or even saline injections [20], whereas other studies reported better results with pain relief and function improvement [21].

Operative treatment: Surgical intervention can be an option for patients with persistent pain and disability that have failed appropriate nonoperative management. The number of patients requiring surgical treatment is estimated about 4% to 11% [22]. There are mainly three surgical approaches, i.e., open, percutaneous, and arthroscopic techniques. The surgical focus is to debride the degenerated portion of the ECRB with or without repairing the ECRB tendon. Evidence in the literature indicates fair to good results for these procedures, presenting surgeons with many options for treatment. However, there have been no definite understandings for the mechanism of good outcome.

Open Surgery: Open surgery involves a small lateral incision with dissection and degenerated tendon identification. After debridement of denatured tendon tissues, the main structure of the tendon can be repaired, lengthened, and fixed by drilling or decortication of the lateral epicondyle [23]. Nirschl and Pettrone et al reported 88 elbow surgical cases out of clinical series of 1,213 patients which involved excision and repair of the ECRB tendinosis tissue. The short-term outcomes of the original procedure were described as good to excellent by 85% of patients with an overall improvement rate of 98% and a return to full activity in 85% of patients [24]. Coleman et al. [25] reported their 15 years of experience in treating refractory LE. Amongst 158 consecutive patients treated with open surgery, 94.6% achieved good or excellent results at an average follow-up of 9.8 years. Although the results of open surgery are positive, there is also a risk of instability of the elbow since excessive dissection of the LE may injure the lateral ligaments.

Percutaneous Surgery: Percutaneous surgical approach is mainly used for releasing the common extensor tendon origin at the lateral epicondyle. This technique has been demonstrated to be safe, reliable, and cost-effective [26]. Good midterm outcomes in pain relief have been widely reported with a percutaneous surgical approach. However, Pierce et al. [27] reported that arthroscopic and open techniques achieved a better prognosis than the percutaneous surgical approach for the treatment of LE.

In recent years, a novel technique termed as ultrasound-guided percutaneous tenotomy (UGPT) has been reported as a safe and effective procedure for the treatment of LE, with durable improvements in terms of symptoms, function, and ultrasound imaging at 1-year follow-up [28]. Seng et al. [29] reported 20 patients with refractory LE treated with UGPT. The results demonstrated that UGPT procedures could provide sustained pain relief and functional improvement for recalcitrant cases at 3-year follow-up. Boden et al. [30] compared the effects of PRP and UGPT procedures in the treatment of medial and LE. No statistically significant difference was found between the two treatment modalities. They concluded that PRP and UGPT procedures were both effective in aspect of pain relief and the improvement of function and life quality.

Arthroscopic surgery: Elbow arthroscopy has been used for the treatment of LE as well. It was first described by Baker and considered as a minimally invasive and efficient surgical procedure [31]. The major advantages of this procedure are quick return to work and the ability to treat the potential intra-articular pathology through visualization of the entire elbow joint. Baker et al. [31] reported that 87% of LE patients

undergoing elbow arthroscopy had good long-term follow-up results. Various studies have shown a lower complication rate of arthroscopic treatment than that of open and percutaneous approach [32]. However, recent systematic review studies reported a compromise result, demonstrating no differences among open, arthroscopic, and percutaneous surgical techniques for LE regarding the duration of return to work, complication rate, or patient satisfaction [32]. Although there are generally positive results, elbow arthroscopy is thought to have a demanding learning curve with potentially risks of damage to the radial nerve and the lateral ulnar collateral ligament.

Conclusion: LE is a common cause of pain and disability affecting patients aged between 35 and 55 years. Most cases have a self-limiting course of between 12 and 18 months. However, symptoms can be persistent and refractory, thus needing interventional measures. Nonoperative treatment remains the priority and mainstay for LE however its important to know that for resistant cases PRP, Autologous blood therapy and surgical treatments are the only feasible options. Most cases can be well treated with multiple nonoperative treatments, with as high as 90% success rate. However, there is no evidence suggesting the superiority of nonoperative treatment options. When nonoperative treatment fails, three surgical interventions will be recommended for patients with lateral LE, including open, percutaneous, and arthroscopic approaches. Similarly, no conclusions on the effectiveness of surgical interventions can be reached mainly due to a lack of high-quality evidence and inconsistent outcome measures.

References:

1. Allander E. Prevalence, Incidence, And Remission Rates of Some Common Rheumatic Diseases Or Syndromes. *Scand J Rheumatol*. 1974;3(3):145–153.
2. Verhaar JA, Elbow T. Anatomical, epidemiological and therapeutic aspects. *Int Orthop*. 1994;18(5):263–267.
3. Calfee RP, Patel A, DaSilva MF, Akelman E. Management of lateral epicondylitis: current concepts. *J Am Acad Orthop Surg*. 2008;16(1):19–29.
4. Haahr JP, Andersen JH. Prognostic factors in lateral epicondylitis: a randomized trial with one-year follow-up in 266 new cases treated with minimal occupational intervention or the usual approach in general practice
5. Degen RM, Conti MS, Camp CL, Altchek DW, Dines JS, Werner BC. Epidemiology and Disease Burden of Lateral Epicondylitis in the USA: Analysis of 85,318 Patients. *Hss J*. 2018;14(1):9–14.
6. Herquelot E, Bodin J, Roquelaure Y, et al. Work-related risk factors for lateral epicondylitis and other cause of elbow pain in the working population. *Am J Ind Med*. 2013;56(4):400–409.
7. Nirschl RP, Pettrone FA, Elbow T. The surgical treatment of lateral epicondylitis. *J Bone Joint Surg Am*. 1979;61(6A):832–839.
8. Hay EM, Paterson SM, Lewis M, Hosie G, Croft P. Pragmatic ran-domised controlled trial of local corticosteroid injection and naproxen for treatment of lateral epicondylitis of elbow in primary care. *BMJ*. 1999;319(7215):964–968.
9. PoschJN,GoldbergVM,LarreyR.Extensorfasciotomyfortenniselbow: a long-term follow-up study. *Clin Orthop Relat Res*. 1978;135:179–182.
10. Knutsen EJ, Calfee RP, Chen RE, Goldfarb CA, Park KW, Osei DA. Factors Associated With Failure of Nonoperative Treatment in Lateral Epicondylitis. *Am J Sports Med*. 2015;43(9):2133–2137.
11. Hsu S. H., Moen T. C., Levine W. N. “Physical examination of the athlete's elbow. *The American Journal of Sports Medicine*. 2012;40(3):699–708. doi: 10.1177/0363546511428869.
12. Dorf E. R., Chhabra A. B., Golish S. R., McGinty J. L., Pannunzio M. E. Effect of elbow position on grip strength in the evaluation of lateral epicondylitis. *The Journal of Hand Surgery*.

2007;32(6):882–886. doi: 10.1016/j.jhsa.2007.04.010.

13. Ahmad Z., Siddiqui N., Malik S. S. Lateral epicondylitis: a review of pathology and management. *The Bone & Joint Journal*. 2013;95(9):1158–1164. doi: 10.1302/0301-620x.95b9.29285.
14. Tang S, Wang X, Wu P, et al. . Platelet-rich plasma vs autologous blood vs corticosteroid injections in the treatment of lateral epicondylitis: a systematic review, pairwise and network meta-analysis of randomized controlled trials. *PM&R* 2020;12:397–409
15. Bisset L. M., Vicenzino B. Physiotherapy management of lateral epicondylalgia. *Journal of Physiotherapy*. 2015;61(4):174–181. doi: 10.1016/j.jphys.2015.07.015.
16. Söderberg J., Grooten W. J., Äng B. O. Effects of eccentric training on hand strength in subjects with lateral epicondylalgia: a randomized-controlled trial. *Scandinavian Journal of Medicine & Science in Sports*. 2012;22(6):797–803. doi: 10.1111/j.1600-0838.2011.01317.x
17. Notarnicola A., Moretti B. The biological effects of extracorporeal shock wave therapy (eswt) on tendon tissue. *Muscles, Ligaments and Tendons Journal*. 2012;2(1):p. 33
18. Edwards S. G., Calandruccio J. H. Autologous blood injections for refractory lateral epicondylitis. *The Journal of Hand Surgery*. 2003;28(2):272–278. doi: 10.1053/jhsu.2003.50041
19. Qian X., Lin Q., Wei K., Hu B., Jing P., Wang J. Efficacy and safety of autologous blood products compared with corticosteroid injections in the treatment of lateral epicondylitis: a meta-analysis of randomized controlled trials. *PM&R*. 2016;8(8):780–791. doi: 10.1016/j.pmrj.2016.02.008.
20. Palacio E. P., Schiavetti R. R., Kanematsu M., et al. Effects of platelet-rich plasma on lateral epicondylitis of the elbow: prospective randomized controlled trial. *Revista Brasileira de Ortopedia*. 2016;51(1):90–95.
21. Thanasas C., Papadimitriou G., Charalambidis C., Paraskevopoulos L., Papanikolaou A. Platelet-rich plasma versus autologous whole blood for the treatment of chronic lateral elbow epicondylitis: a randomized controlled clinical trial. *The American Journal of Sports Medicine*. 2011;39(10):2130–2134. doi: 10.1177/0363546511417113
22. Kniesel B., Huth J., Bauer G., Mauch F. Systematic diagnosis and therapy of lateral elbow pain with emphasis on elbow instability. *Archives of Orthopaedic and Trauma Surgery*. 2014;134(12):1641–1647. doi: 10.1007/s00402-014-2087-4.
23. Kumar V. S., Shetty A. A., Ravikumar K. J., Fordyce M. J. F. Tennis elbow—outcome following the Garden procedure: a retrospective study. *Journal of Orthopaedic Surgery*. 2004;12(2):226–229. doi: 10.1177/230949900401200217.
24. Nirschl R. P., Pettrone F. A. Tennis elbow the surgical treatment of lateral epicondylitis. *The Journal of Bone and Joint surgery*. 1979;61(6A):832–839.
25. Coleman B., Quinlan J. F., Matheson J. A. Surgical treatment for lateral epicondylitis: a long-term follow-up of results. *Journal of Shoulder and Elbow Surgery*. 2010;19(3):363–367. doi: 10.1016/j.jse.2009.09.008.
26. Grundberg A. B., Dobson J. F. Percutaneous release of the common extensor origin for tennis elbow. *Clinical Orthopaedics and Related Research*. 2000;376(376):137–140. doi: 10.1097/00003086-200007000-00019.
27. Pierce T. P., Issa K., Gilbert B. T., et al. A systematic review of tennis elbow surgery: open versus arthroscopic versus percutaneous release of the common extensor origin. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*. 2017;33(6):1260–1268.e2. doi: 10.1016/j.arthro.2017.01.042. [
28. Koh J. S., Mohan P. C., Howe T. S., et al. Fasciotomy and surgical tenotomy for recalcitrant lateral elbow tendinopathy. *The American Journal of Sports Medicine*. 2013;41(3):636–644. doi: 10.1177/0363546512470625.
29. Seng C., Mohan P. C., Koh S. B. J., et al. Ultrasonic percutaneous tenotomy for recalcitrant lateral elbow tendinopathy. *The American Journal of Sports Medicine*. 2015;44(2):504–510. doi: 10.1177/0363546515612758.
30. Boden A. L., Scott M. T., Dalwadi P. P., et al. Platelet-rich plasma versus Tenex in the treatment of medial and lateral epicondylitis. *Journal of Shoulder & Elbow Surgery*. 2019;28(1):112–119. doi:

10.1016/j.jse.2018.08.032.

31. Baker C. L., Jr, Baker C. L. Long-term follow-up of arthroscopic treatment of lateral epicondylitis. *The American Journal of Sports Medicine*. 2008;36(2):254–260. doi: 10.1177/0363546507311599.
32. urn M. B., Mitchell R. J., Liberman S. R., Lintner D. M., Harris J. D., McCulloch P. C. Open, arthroscopic, and percutaneous surgical treatment of lateral epicondylitis: a systematic review. *HAND*. 2018;13(3):264–274. doi: 10.1177/1558944717701244.

Pitfalls of Proximal Femoral Nailing and How to Avoid them?

Dr. B. Shivashankar

Consultant Orthopaedic Surgeon and Traumatologist.

Iyer Orthopaedic Centre, 03, Railway Lines, Solapur – 413001, Maharashtra

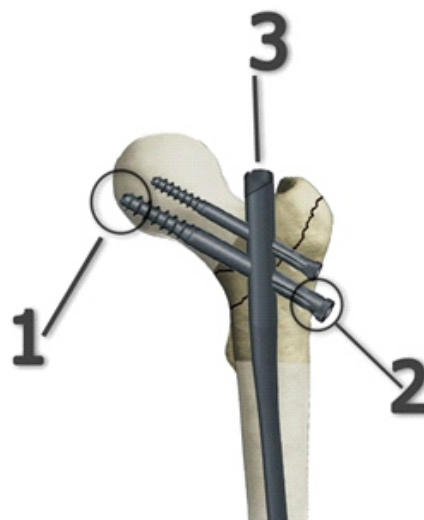
drbshivashankar@gmail.com

The treatment of intertrochanteric (IT) fractures in the elderly is a challenging. The bones are osteoporotic with implants having less hold as well as the co-morbidities associated in these elderly leads to almost one-third mortality by the end of one year, which is a major global economic burden. The hip fractures accounted for over 250,000 fractures in US itself every year. The worldwide problem at present stands at over 2 million fractures and it is bound to triple by the next 50 years due to the elderly surviving more with better healthcare facilities. The treatment option for osteosynthesis includes open/closed reduction and fixation either with surface implants such as dynamic hip screw (DHS) or intramedullary (IM) implants such as proximal femoral nail (PFN).

Approximate period between 1999 and 2010, most of the studies and the Cochrane reviews were advising DHS or the sliding Hip screw for Stable IT fractures whereas for unstable fractures, the IM implants were advocated. Now, most of the studies including the recent Cochrane data advocates the use of IM hip implants both for stable and unstable fracture. The author also prefers and advocates the same. He says that learn the technique of PFN in simple stable fractures first and then gradually master to treat complex unstable fractures. There are studies done in USA where the cost of treatment either with DHS or PFN are the same and in the early 2000 when there was not much evidence to treat stable fractures with PFN, the surgeons still preferred to treat them with PFN over the DHS/SHS. But over the years the surgeons treating IT fractures with a DHS has become minuscule and almost all prefer to treat them now with IM Nail. The author has designed a Key Hole DHS technique with incision as small as just 2 cms but, in spite of that, he prefers to treat the IT fractures with a PFN. (Shivashankar, B., Shah, S., Kumar, G. *et al.* Keyhole Sliding Hip Screw Fixation for Stable Intertrochanteric Hip Fractures: A Novel Technique. *JOIO* **56**, 1101–1107 (2022). <https://doi.org/10.1007/s43465-022-00624-5>).

Before discussing about some of the pitfalls, let us first know, which are the important things in a PFN which gives good fixation.

Figure 1: Picture showing three important points of fixation of a IM Implant. Namely Subchondral Screw Placement, Neck screw slightly out of lateral cortex or resting against lateral cortex and finally the nail slightly out at the entry point.



Reduction is the most important aspect of any fracture. The outcome of any surgery mainly depends upon the skill of the surgeon how best he can reduce the fracture in the given situation. Once a fracture is reduced well, it can be stabilised in that reduced position by using any of the so many varieties of IM implants which are available in the market. The author prefers PFN and TFN with two screw system as first choice, though many surgeons prefer to use a single neck screw system like PFN A2 due to its easy in usage and surgeon friendly instrumentation set.



Fig 1: Showing varus reduction

- 1. Varus Reduction:** The most important cause for failure in PFN is varus reduction. This could be due to inability to access the hip from an eccentric entry due to positional problem or due to improper entry. Normally all these cephalomedullary nails became more popular due to their easy entry from the tip of the trochanter, but unfortunately as the bone is softer more on the outer aspect, the entry site automatically gets reamed more on the outer aspect and causing tilt of the entry site much more lateral inadvertently, which leads to varus. This can be avoided by proper entry from medial to the base of greater trochanter or even better is taking the entry on the neck itself like piriformis fossa entry (Piriformis entry is a misnomer. It is in AP looks like piriformis fossa entry, but in lateral it is more in the centre rather posterior like piriformis fossa entry for femoral nailing). So let us discuss how we can avoid this varus by proper positioning of the patient and also by taking proper entry.

1a. Position: For doing any hip surgery, the surgeon must be comfortable and he should have good access to the hip. The author prefers eccentric placement of perineal post (Fig. 1a), so that after reduction and fixation with K wires, the limb can be adducted to get easy access of the hip to pass the nail more on the medial side of greater trochanter or from the neck itself. This eccentric placement of the perineal post helps in adducting the limb without the worry of fracture opening superiorly to cause varus which happens due to thigh touching the perineal post.. To prevent the patient sliding back from eccentric position to centric position, author uses a small sand bag tied to the table as shown in Fig 1b and 1c. The author also tilts the table by about 15 to 20 degrees on the normal side (Fig 1d and 1e). Few surgeons prefer lateral decubitus position but the author prefers to operate these IT fractures on a traction table and only sub trochanteric fractures he prefers to use lateral position.



Fig1a: Eccentrically placed patient on Orthopaedic Traction Table. Perineal post will not prevent adduction of the limb.



Fig 1b. View from above and Fig 1c. View from side: Showing perineal post and the sand bag to prevent patient sliding back to centre from the eccentric placement as shown in Fig 1a.

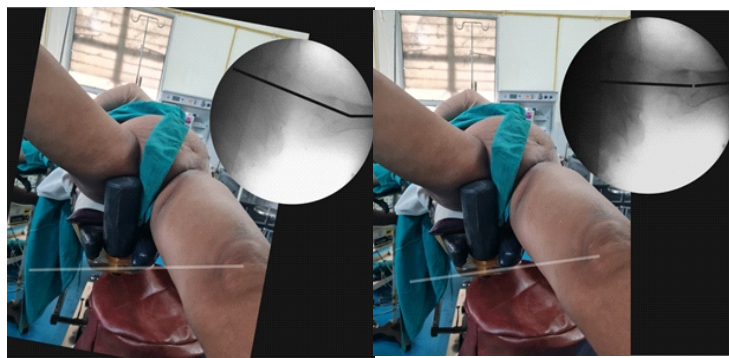


Fig 1d and 1e: Showing table horizontal with femoral Neck anteverted in C arm where as by tilting the table on normal side, the head and neck comes more in line with the shaft. This helps in easy visualisation of true lateral view of hip and also patient falls due to gravity more on normal side

1b. Entry Point: The author strongly recommends for all nailings of the femur by any implant entry in line with the medullary canal. He feels that shifting entry more laterally from the tip of trochanter is the basis of mal reduction and in turn failure due to varus. He also feels that the tip of the trochanter is more laterally placed in Asians compared to Caucasians in whom the medullary canal is almost in line with the tip of the trochanter (personal view of author, which needs to be supported by a large.



Fig 2a: Showing Piriformis Entry



Fig 2b: Showing Entry medial to the base of Trochanter

). The entry point has to be done in line with the medullary canal, which is almost always either the piriformis fossa (fig 2a), which is a misnomer as piriformis fossa is much more posterior in the lateral view and not in the central part where the entry is taken for cephalomedullary nails, this area is medial to the tip of trochanter at its base in AP and centre of neck in lateral view (Fig. 2b).

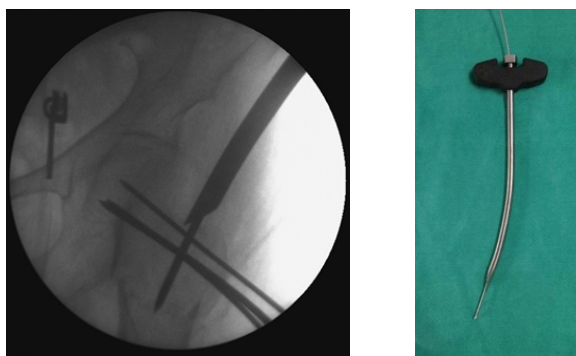


Fig 2c and 2d: Showing Sharp Curved Awl to remove strong neck bone

studyOne should take care to enlarge the entry site, which is on the thick cortical bone of the neck by sharp awl (Fig 2c and 2d) or by a cheese cutter (Fig 2e,f and g) and avoid the entry site getting lateralised.

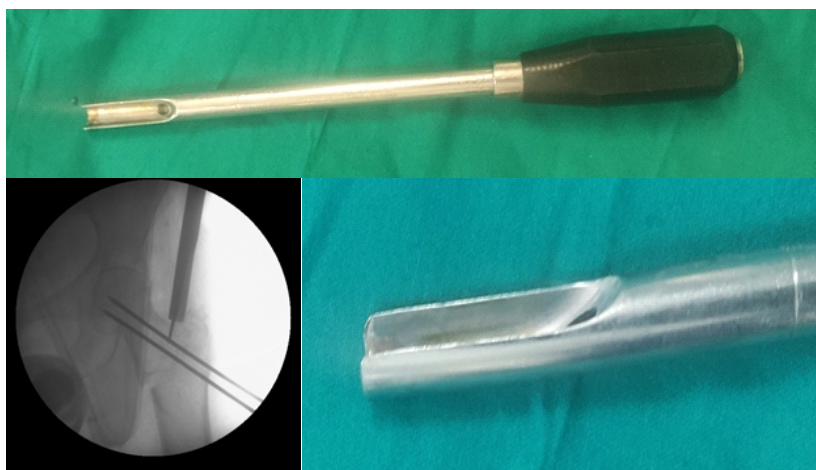
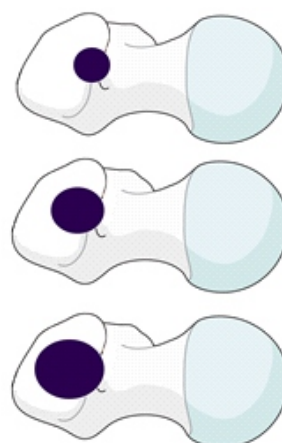


Fig 2e, 2f and 2g: Showing Cheese cutter being used to remove strong neck bone to prevent lateralisation of entry point

As the bone is weaker on the lateral aspect, while passing the centering awl or the entry reamer, more bone gets removed on outer aspect and the entry site will get lateralised inadvertently leading to varus happening (Fig. 2h)

This in turn leads to the head and neck tilting in varus as well as screw position not proper in the head and neck, (screw in the inferior part of the neck will be central or in superior portion of the head) leading to early cut out of the improperly placed neck screw in a varus head

Fig 2h: Entry getting lateralised due to softer bone on outer aspect of the entry site.



1. **Reduction:** The second most common problem is inability to get a proper reduction. Majority of the time the beak of the proximal fragment or the neck will be lying inside the medullary canal of the shaft and the surgeon feels it as a stable reduction like a Dimon- Hughston reduction, which is a stable reduction for a surface implant like DHS..

2a. Reduction and Temporary K Wire fixation: The foremost important factor for successful outcome with intramedullary nailing is reduction. Reduction has to be good both of medial as well as anterior cortex.. The reduction can be assisted either by manipulating the fragment by closed techniques or by percutaneous mini-open techniques such as using a bone lever, bone spatula, bone hook, and collinear clamps The author prefers to use percutaneously passed Steinmann pin (Fig 3a) for intra focal manipulation and prefers to fix with two Kirschner's wires of 2.5 mm thickness placed more anteriorly in the head and neck (Fig 3b), so that they will not hinder the further steps of surgery like either passing of the nail or the neck screws. Once the fracture is fixed with 2 K wires after reduction, the limb can be adducted (Fig 3c and 3d) as needed without the worry of fracture going into varus or the fracture opening superiorly especially while reaming with centering awl to lead to varus and the nail can be passed easily.

Good medial reduction (positive cortical reduction) or the valgoid reduction of at least 5 degrees more in valgus compared to the normal side is also very important. While reducing make sure that neck beak is outside the distal fragment (positive cortical reduction) and should not enter into the shaft (negative cortical support) (Fig 3e, 3f and 3g). One should aim at neutral with valgus or Positive cortical reduction. This can be done by intrafocal Steinmann pin pushing the beak out medially and reducing the foot traction minimally so that beak will overlap medially on the beak of the shaft and it can never slip back inside the distal canal due to this few mm overlap (Fig. 3n).

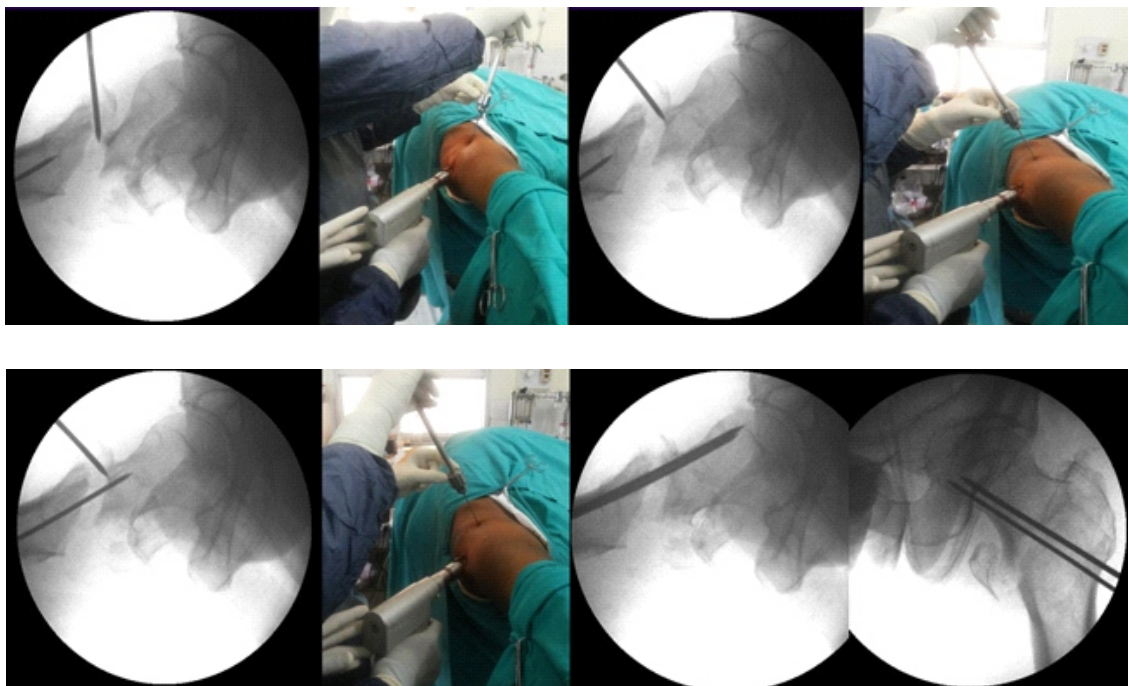


Fig 3a and 3b: Showing reduction technique by percutaneous intrafocal manipulation with Steinmann Pin

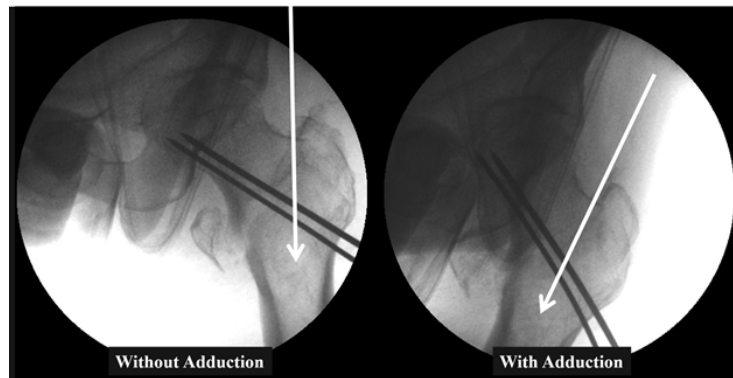


Fig 3c and 3d: Showing Nail Entry made easy by adducting the limb after fixation with 2 Kirshner Wires.

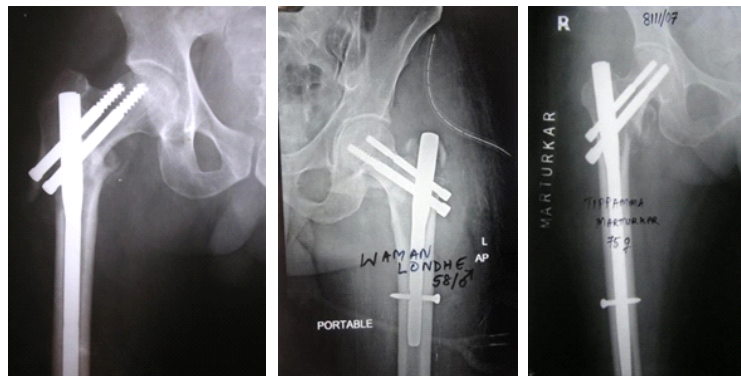


Fig 3e, 3f and 3g: Showing Negative, Neutral and Positive Cortical Support

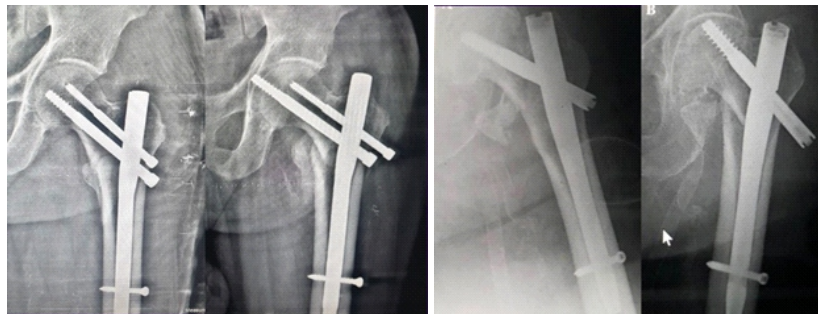


Fig 3h, 3i and 3j: Showing Neutral Reduction with Lesser Trochanteric Avulsion slipping into Negative cortical Support.



Fig 3l and 3m: Showing Reduction in Additional valgus when lesser trochanteric void present leading to good union.



Fig 3n: Showing over lapping of the beak by reducing the traction after pushing the beak out medially. This overlap of beak over shaft prevents beak slipping inside medullary canal.

If there is a large medial fragment of lesser trochanter extending into the subtrochanteric area, the author prefers to fix them with encirclage wiring. In just avulsion of lesser trochanter, even if you do not open or reduce it into its bed, a good valgus compensates for the medial void very well (Fig 3l and 3m).

If there is a large medial fragment, fixing them with a encirclage wiring (Fig 3o and 3p) as the first step as this gives stability to the fracture and helps in early union. Minor fragments can be left alone if fracture is treated by closed methods, but if large fragments are left alone, it takes more time for the fragment to get incorporated and heal and hence the author advocates anatomical reduction and wiring whenever possible.

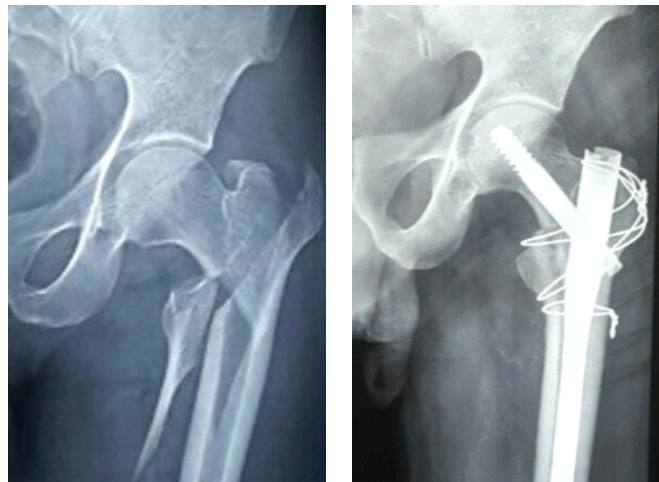


Fig 3o and 3p: Showing large medial fragment along calcar and weight transmission axis being fixed first with an encirclage wire.

3. **Passing Nail through fracture site:** This is another major common mistake which is noticed by the author. Many a times surgeons feels that, as the fracture is due to severe osteoporosis and the bone is soft and comminuted, he shovels the nail through the fracture without making any space for the nail or by not using the proximal reamer or the centering reamer(Fig 4a and 4b). Sometimes it is due to not using the proximal reamer or the centering awl properly to ream the canal. The reamer is inserted at the fracture site and reaming is done, unfortunately sometimes if the bone is strong, this reamer doesn't ream the proximal canal well and the fractured bone surfaces just gets separated from one another while the reaming is being carried out. Once the nail is passed after this improper proximal canal preparation, the nail distracts the fracture surfaces and acts as a spacer. (Fig 4c and 4d).Thus reducing the contact of fractures ends as well as

lateralising the femoral shaft. Which in turn leads to longer neck screws to be used. The longer neck screws will have more stress at the nail screw junction leading to improper sliding and failure in due course of time which is mainly varus collapse of the head and cut out of the jammed screws superiorly.

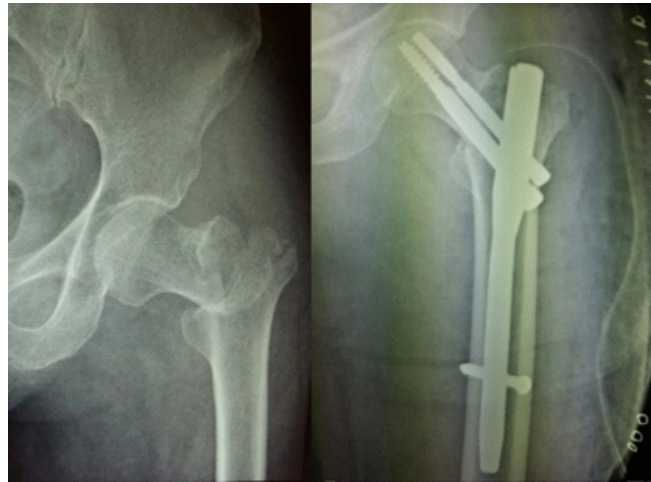


Fig. 4a and 4b: Showing Nail Passed through fracture site causing widening of GT and Varus reduction.



Fig. 4c and 4d: Showing proximal centering reamer passed through fracture site not reaming the canal well and hence the nail subsequently acting as a spacer separating the fracture surfaces, causing varus and inability to pass superior derotational screw

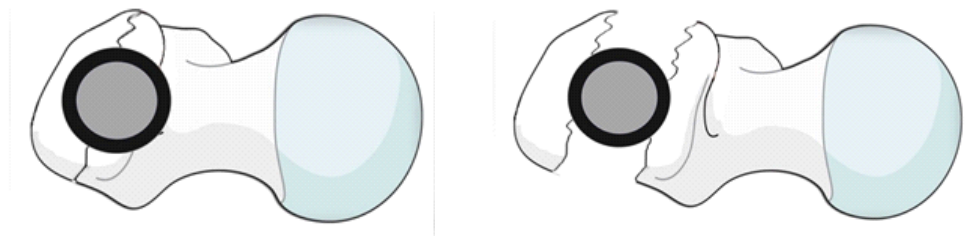


Fig 4e: Showing nail passed after preparing proper canal for the nail at the entry site. Fig 4f: Nail acting as a spacer due to improper canal preparation causing loss of fracture contact as well as lateralisation of the shaft.

3a. Eccentric Placement of Patient on the table: Normally, the perineal post will be in the centre, but on adduction, the thigh touches the perineal post and on further adduction, the perineal post becomes the fulcrum against which the thigh will be adducted and the fracture opens up superiorly leading to varus. Many a times even an Undisplaced fracture on adduction and trying to ream with centering awl, fracture opens up superiorly leading to varus. Sometimes the surgeon notices the varus happening at the fracture and he tries to abduct the limb after passing the nail, during this procedure the fracture opens up inferiorly also leading to lateralisation of the shaft. The nail will be acting as a spacer and distracting the fracture site and also the length of the neck screws required will be much longer than expected. Here are few diagrammatic representation of the distraction and lateralisation cause due to shovelling of the nail through the fracture site without preparing the canal properly.

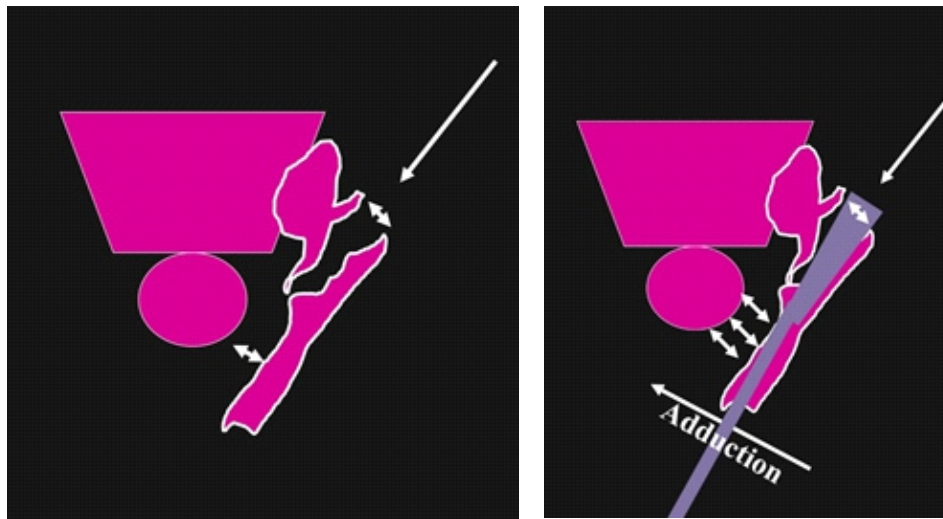
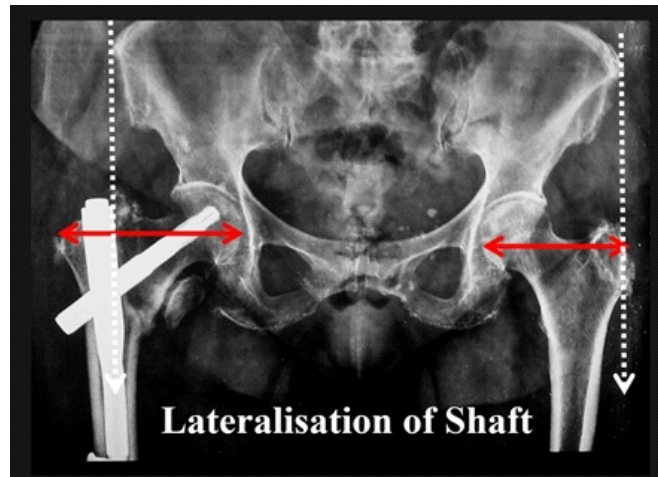


Fig.4g and 4h: Showing central perineal post acting as a lever when thigh is adducted causing opening of the fracture superiorly and the nail inserted in adduction causing distraction at the fracture site.



Fig 4i: Showing surgeon abducting the limb to correct varus after nail insertion causing distraction at the fracture site causing lateralisation of shaft requiring longer neck screws.



X ray 4j: Showing lateralisation of the shaft due to insertion of nail through fracture site without proper reaming. Normally the line dropped from outermost part of pelvis (White dotted line) just grazes the trochanter or passes tangentially. On the operated side due to shaft lateralisation, note that it passes more medially. Though the fracture has united here, the biomechanics of the hip will be altered and the patient will limp due to the lateralisation of shaft and will have Trendelenberg gait.

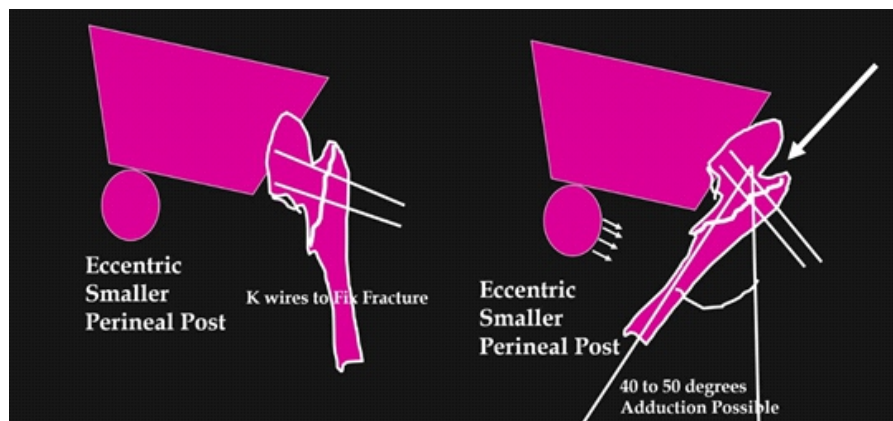


Fig 4k and 4l: Showing Eccentric smaller perineal post against normal side ischeal tuberosity, which doesn't hinder adduction. Fracture fixed with K wires after reduction and then adducted to make nail entry easy. Please note that the pelvis tilting caused due to eccentric perineal post is compensated by large adduction possible without the worry of perineal post hindering the adduction. Compare this with Fig 1a showing clinical picture of position.

- a) **Fixing the Fracture with K wires:** As described earlier in detail, fixing the fracture after reduction with K wires helps in adducting the limb as much as required without the worry of fracture going into varus. These K wires also helps in proper reaming with the entry reamer without causing separation of the fracture surfaces, as shown in fig 3e and 3f.

4. **Improper Neck Screw Placement:** Many a complications are due to improper placement of the neck screws. The Cervical screw which is inferior in the neck will be either in the center or superior portion of the head



Fig. 5a: X ray showing Superior Screw longer taking brunt of the hip vector force leading to screw breakage.



Fig 5b: Right side hip showing breakage of longer derotational screw, where as left hip shows ideal tip position of both screws at same horizontal level.

4a. Proper placement of Neck Screws: Neck screws should be placed parallel to the calcar, in the centre or inferior third of the neck in AP view so that the tip of the screw should also be in the inferior part of the head and not at the centre or superior portion of the head (Fig 5a). This will allow easy sliding of the neck screw within the nail and causes less jamming. Similarly in the lateral view, it should be in the centre or slightly posterior to the centre so that it has the best purchase in the strongest part of the bone. For passing these screws properly over guide wire, one should use the trocar first to make the starting hole in the lateral cortex of the bone. The long Guide wires of 1.8–2mm are not made for drilling the thick lateral cortex like the drill bits and they may slip over the bone especially due to longer lever arm from the other end where drill machine is attached.(Fig 5c). Author prefers to use the two screw system and if, two screw system are used, both the neck screw should preferably end at a same horizontal plane, the derotation screw being little smaller and shorter. This helps in easy sliding of both the screws, while if superior derotational screw is longer, the load is taken predominantly by this screw leading to breakage or the sliding mechanism getting jammed due to stress in the screw nail junction leading to Z effect.

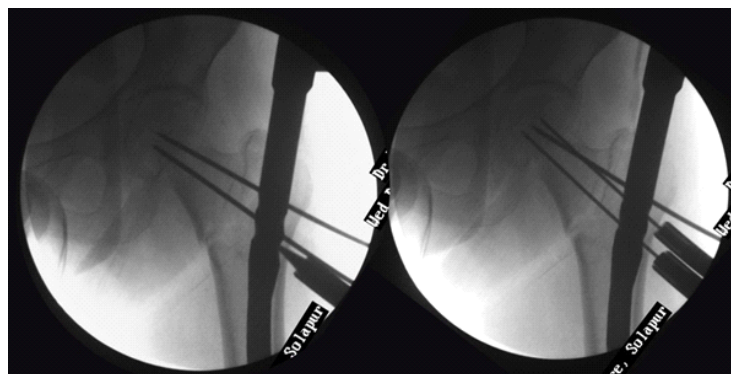


Fig 5c: Showing Trochar used to drill the lateral cortex before passing the thin long neck guide wires of PFN /TFN

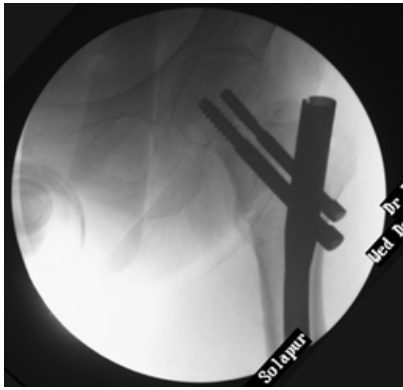


Fig 5d: Showing Screw Position inferior third in Neck as well as head. Note that both the screw ending almost at same level.

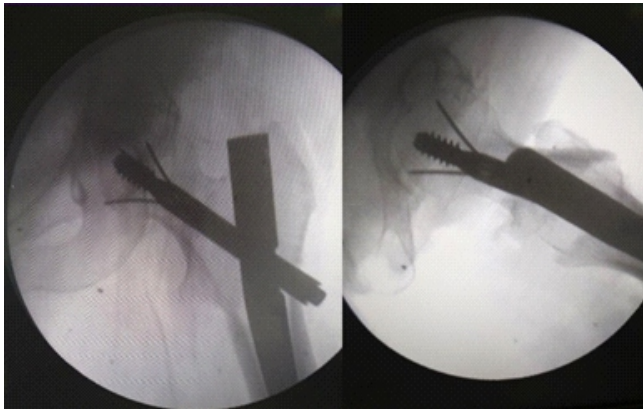


Fig 5e and 5f: Showing Neck Screw inferior in AP and Posterior in lateral view

4b. TAD of Neck Screw: TAD more leading to neck screw not having good purchase leading to screws backing out is another common pitfall noticed. The best purchase any neck screw will have is in the sub chondral bone and hence, the neck screw should be placed as sub chondral as possible, so that TAD is very less. As the author prefers neck screw placement in the inferior part of the head and neck, if TAD is measured from fovea centralis, even though the screw is sub chondral, the TAD measured will be more in spite of screw being in a very good and strong bone position. Hence one should measure not TAD but, The Calcar TAD (Cal TAD), which is measured by extrapolating the screw line to the subchondral bone and where that line meets the articular surface, the TAD is measured from that point instead of measuring from more centrally and superiorly placed fovea Centralis.(Fig 5g) So, we should aim to keep the Cal TAD definitely below 25 mm considering both AP and Lateral picture measurements together.



Fig 5g: Showing TAD and Cal TAD in AP

5. Fracture not compressed: Many a times we all feel that the sliding mechanism in the nail will allow gradual collapse and compression to happen. We all are so much brain washed by the sliding of DHS/SHS, we all feel that sliding and collapse is required in all the implants for the IT fractures to unite. Unfortunately, this sliding is uncontrolled and in some cases, too much of sliding will cause more problems.. The author feels that tthe failure with PFN is also due to uncontrolled collapse in a improperly compressed fracture. Hence he advocates to compress the fracture to satisfaction on table (after releasing the foot traction). **6a)Well Compressed Fracture:** The author feels that the fracture needs to be well compressed on table itself and one should not rely on the uncontrolled inbuilt collapse which can happen by gradual sliding of the neck screws within the nail. Author feels that failures in PFN is mainly due to not adequately compressing fracture which mainly happens due to not releasing the traction before final neck screw tightening or by using a little shorter screw or due to using little longer screw and leaving it out slightly. By using little shorter screw the surgeon tries to reach the subchondral bone and by these extra tightening the shorter screw the threads of the screw looses its purchase and becomes loose in the osteoporotic head. The author further says that the failure are mainly due to head of the neck screw not having the support of the lateral wall which leads to toggling of the screw and to loose purchase in the bone.

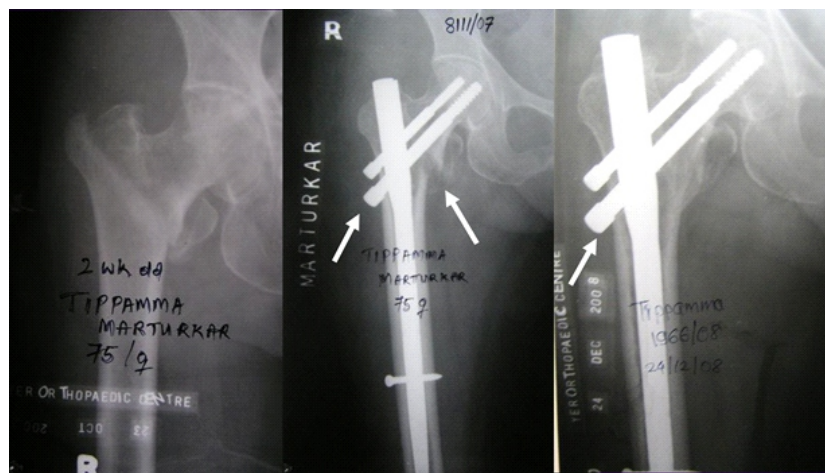


Fig 6a, 6b and 6c: Showing 75 year lady with 2 weeks old osteoporotic IT fracture fixed with PFN. Note the screw head which is against the lateral wall on day one staying there only even after 14 months , indicating adequate compression on table and the fracture did not further collapse. Please also note the Positive cortical support and sub chondral placement of neck screw.

5b.Tips for Headless Neck Screws: The author personally prefers IM Nail for the hip like PFN and TFN which have heads for the neck screw and the fracture can be adequately compressed as required by tightening these neck screws having head against the lateral wall or even against the nail in osteoporotic bones or in cases having deficit lateral wall. There are many newer single neck screw system which are more surgeon friendly due to its ease of usage and passing just a single neck screw and hence they are more popular with the surgeons like PFN A2, ZNN, TFN A etc. All these newer systems do not have head for the neck screw. Hence if these screws are passed inside beyond the lateral cortex hole created, many a times during the course of fracture healing and a bit collapse, these helicle blades cannot slide out of the lateral cortex hole due to mismatch and they cannot slide out leading to these helicle blades penetrating into the joint. So the author advises, if at all these types of implants with neck screw having no heads are used, then it is better to keep the back end of these neck screws or the blades 3 to 5 millimetre out so that they can slide out easily rather than penetrating into the joint during the course of fracture collapse and healing.



Fig 6d: Showing Back end of the headless neck screw going inside the lateral cortex. Which may prevent fracture collapse as the hole in the bone may not match later to allow sliding out of the neck screw.



Fig 6e and 6f: Showing Neck screw slightly kept out of the lateral cortex to allow screw backing out due to fracture collapse, if needed.

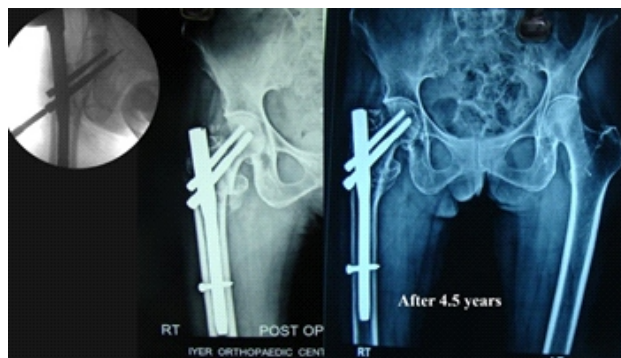


Fig 6g and Composite Fig. 5f: showing IT Fracture with Comminuted lateral wall, here the nail itself acts as the lateral wall and see the heads of the screws resting against the nail instead of the missing lateral wall.(Authors original method of Nail acting as lateral wall)

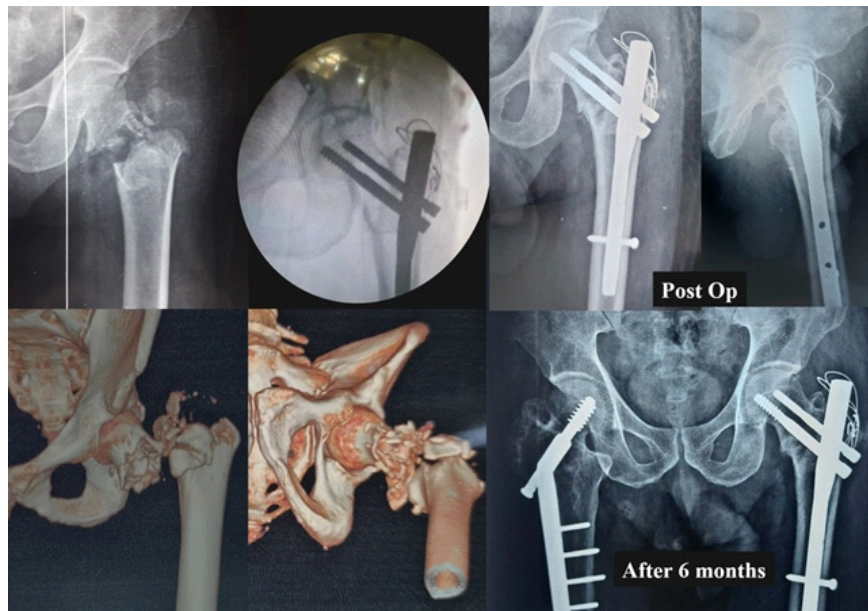
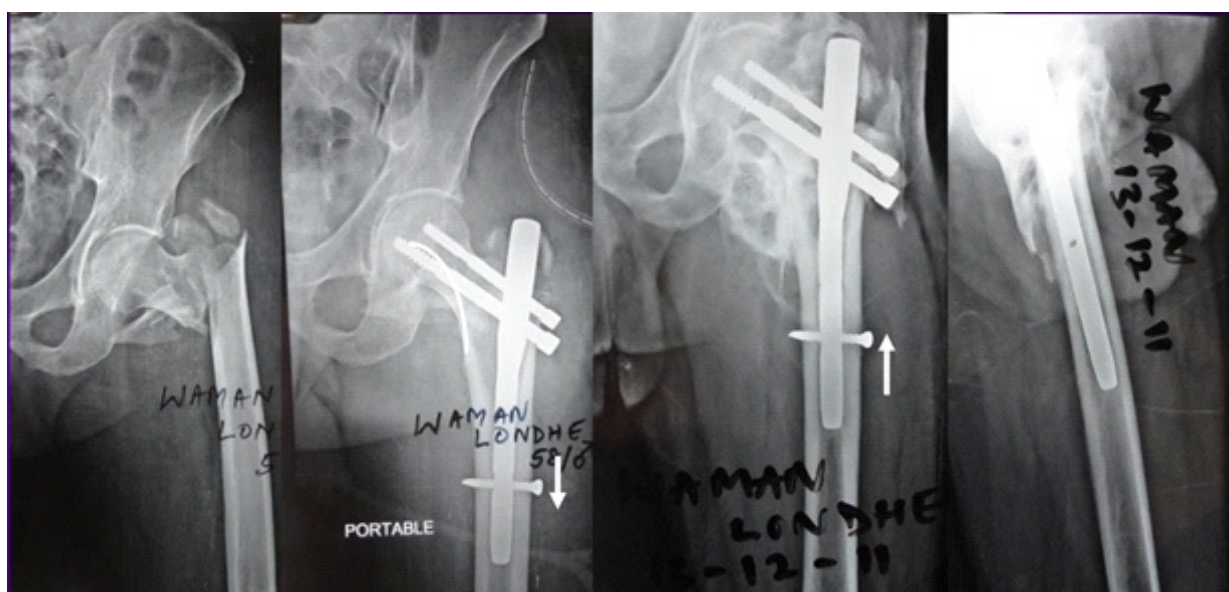


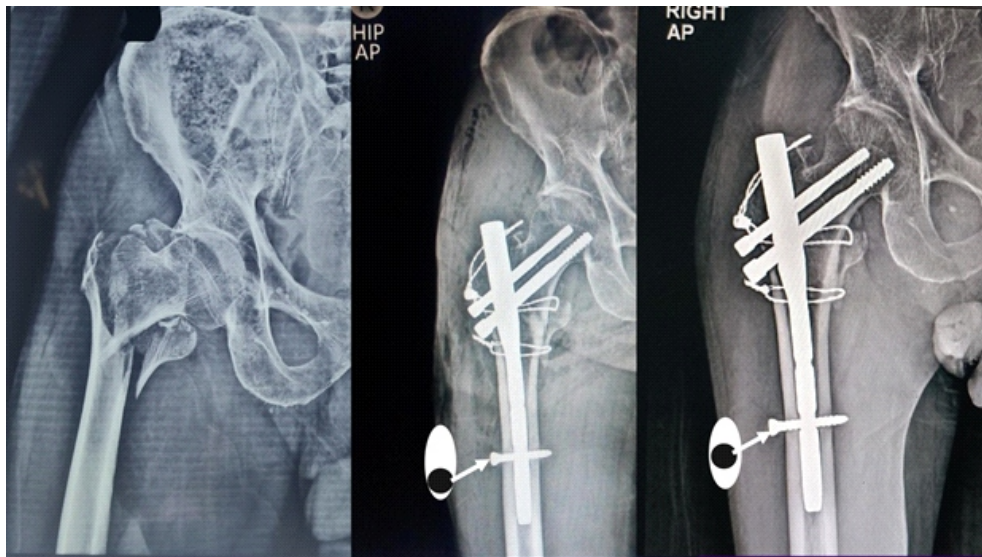
Fig 6g: Composite picture showing IT fracture with comminuted lateral wall and greater Trochanter avulsion, treated with TFN having head for the neck screws, the nail compensating for the missing lateral wall and the screw heads resting against the nail. Wiring of greater trochanteric avulsion has been done. Incidentally, this patient had SHS/DHS on the opposite side and the neck length has decreased due to uncontrolled medialisation of the shaft.

6. **Static Locking / Delayed Dynamisation:** Though there are many literatures showing good out come both with static locking as well as dynamic locking, the author feels that in few cases where fracture resorption is a bit more than normally expected, either they require dynamisation in time at 6 to 8 weeks or it can be dynamically locked from day one itself.

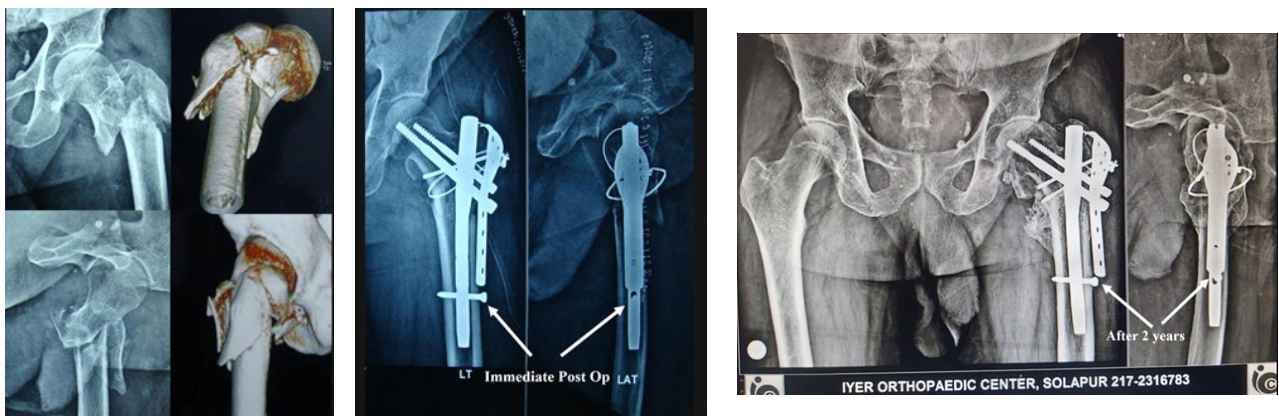
The dynamic locking allows axial micromotion like an Ilizarov fixator while walking with walker in the initial few weeks and helps in throwing secondary callus and early consolidation



Composite Picture Fig 7a: Showing interlocking bolt migrating up due to dynamic locking during the course of fracture healing.



Composite Picture 7b: Showing interlocking bolt position showing dynamisation during the course of fracture healing. Please note that the nail has subsided only by a few mm and the bolt earlier at inferior part of the oblong hole is now shifted up.



Composite Picture Fig 7c: Showing Dynamisation working with nail subsidence in the canal due to fracture collapse and the dynamic locking bolt moving up in the dynamic hole of the nail. Do compare the interlocking bolt position in the X rays of immediate post op with X rays after 2 years



Composite Picture Fig 7d: Showing an example of Static locking, not allowing dynamisation and collapse leading to non union and implant giving away. Also note that as the superior screw is also longer, it has taken the brunt of weight bearing leading to its breakage also.

7. **Choice of implant:** Good implant from a good manufacturer with laser marking to trace back if complication arises and not a poor copy from a fly by night lesser-known company, costing a bit less should be used to avoid complications related to metal quality and strength of the implant. Many of these nails from lesser known companies are having thinner nail causing breakage at the screw hole or they are not tapered or crimped for easy insertion as well as to increase strength of the nail. Many have distal locking very nearer to the tips also causing peri-implant fracture due to stress concentration.
8. **Weight Bearing:** Finally, after a very robust and stable fixation, the patient should be mobilised as pain tolerated weight bearing with a walker to enhance early fracture union and to minimise complications of prolonged immobilisation. Once the patient is made to walk, his/her morale will be boosted and will cooperate for proper physiotherapy also.

These are some of the pitfalls which are commonly noted which are the main causes for failure of the PFN.

References and further reading

1. Shivashankar, B., Keshkar, S. Intertrochanteric Fractures: Ten Commandments for How to Get Good Results with Proximal Femoral Nailing. *JOIO* **55**, 521–524 (2021). <https://doi.org/10.1007/s43465-021-00373-x>
2. Shivashankar, B., Shah, S., Kumar, G. *et al.* Keyhole Sliding Hip Screw Fixation for Stable Intertrochanteric Hip Fractures: A Novel Technique. *JOIO* **56**, 1101–1107 (2022). <https://doi.org/10.1007/s43465-022-00624-5>
3. Bhandari, M., Devereaux, P. J., Tornetta, P., 3rd., Swiontkowski, M. F., Berry, D. J., Haidukewych, G., *et al.* (2005). Operative management of displaced femoral neck fractures in elderly patients. An international survey. *The Journal of Bone and Joint Surgery: American Volume*, **87**(9), 2122–2130.
4. Lenich, A., Vester, H., Nerlich, M., Mayr, E., Stöckle, U., & Füchtmeier, B. (2010). Clinical comparison of the second and third generation of intramedullary devices for trochanteric fractures of the hip—blade vs screw. *Injury*, **41**, 1292–1296.
5. Sadowski, C., Lübbecke, A., Saudan, M., Riand, N., *et al.* (2002). Treatment of reverse oblique and transverse intertrochanteric fractures with use of an intramedullary nail or a 95 degrees screwplate: a prospective, randomized study. *The Journal of Bone and Joint Surgery: American Volume*, **84A**, 372–381.
6. Anglen, J. O., Weinstein, J. N., & American Board of Orthopaedic Surgery Research Committee. (2008). Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice. A review of the American Board of Orthopaedic Surgery database. *The Journal of Bone and Joint Surgery: American Volume*, **90**, 700–707.
7. Sanders, D., Bryant, D., Tieszer, C., Lawendy, A.-R., MacLeod, M., Papp, S., *et al.* (2017). A multicenter randomized control trial comparing a novel intramedullary device (InterTAN) versus conventional treatment (sliding hip screw) of geriatric hip fractures. *Journal of Orthopaedic Trauma*, **31**, 1–8.
8. De Castro, J., Unsay, I. C., Huat, T., & Kee, E. K. B. (2020). Early experience with the trochanteric fixation nail-advanced (TFN-A): A descriptive review of thirty-four cases from a single center. *The Indian Journal of Orthopaedics*, **54**(Suppl 2), 246–253.

9. Chang, S.-M., Zhang, Y.-Q., Ma, Z., Li, Q., Dargel, J., & Eysel, P. (2015). Fracture reduction with positive medial cortical support: A key element instability reconstruction for the unstable pertrochanteric hip fractures. *Archives of Orthopaedic and Trauma Surgery.*, 135(6), 811–818.
10. Baumgaertner, M. R., Curtin, S. L., Lindskog, D. M., & Keggi, J.M. (1995). The value of the tip apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *Journal of Bone and Joint Surgery: American Volume*, 77, 1058–1064.
11. Aicale, R., & Maffulli, N. (2018). Greater rate of cephalic screw mobilisation following proximal femoral nailing in hip fractures with a tip–apex distance (TAD) and a calcar referenced TAD greater than 25 mm. *Journal of Orthopaedic Surgery and Research.*, 13, 106.

Dilemmas in the management of displaced Three/Four part proximal humerus fractures

Dr. M. Ajith Kumar
Senior Consultant,
Tejasvini hospital,
Mangalore

Proximal humerus fractures constitute 4-5% of all fractures and they are the 2nd most common upper limb fracture and 3rd most common in elderly osteoporotic patients with low energy trauma. With increasing patient demographics and particularly in the elderly population across the globe the incidence of osteoporotic fractures is reaching epidemic proportions. Management strategies for these fractures vary from slab, brace, percutaneous pinning, ORIF, Intramedullary Nailing and replacement which could be hemi replacement, Total shoulder arthroplasty or reverse shoulder arthroplasty.

Improved life expectancy and overall health of this population has made an active lifestyle a necessity. Hence, the proximal humerus fractures which were usually managed conservatively in over 90% of the patients hitherto, are now subjected to surgical intervention especially in the last two decades. The reasons for this change in approach could be due to three predominant reasons. First, the more active lifestyle of these elderly patients. Second, the perceived improvement in the internal fixation devices. Third reason could be the increase in sub-specialization which has improved outcomes in focused areas, probably at the cost of blurring the indications for surgical intervention.

Although the trend towards surgery in these fractures are on an upward swing, it is not entirely backed by current evidence. High energy fractures which are markedly displaced, particularly fracture dislocations warrant surgical intervention. But the sheer increase in the surgical numbers is not just due to increase in the population size or increase in high velocity injuries. A major reason for the surge in the numbers of surgical intervention is patient and family demands rather than evidence based practice. By and large, most studies employ the Neer's classification and the Neer's criteria for determining conservative versus operative treatment. Displacement of >1cm and angulation of >45degrees would be considered for surgical intervention in 3 and 4 part fractures of the proximal humerus.

Most conservative management protocols suggest 2 to 4 weeks' immobilization in a sling/velpeau bandage followed by passive mobilization at 2 weeks and active exercises at 4 weeks. Most studies had good outcomes with a Constant score of 64.5 for 3 part fractures and 54.9 for four part fractures. The complications of conservative management being nonunion in 7.5%, malunion in 21%, AVN in 9% and 4.5% post traumatic arthroses.

Following surgical fixation, nonunion of 4%, malunion of 27%, AVN of 7% and post traumatic arthroses in 1.8%. The constant score for 3 part fractures was 64%.

On the other hand, for 4 part fractures which were operated there was nonunion of 10%, malunion of 17%, AVN of 10% and post traumatic arthroses in 6%, with a constant score of 54.9%.

Author	Fracture type	Treatment
Van den Broek et al. 2007 [11] <i>Arch Orthop Trauma Surg</i>	3- and 4-part Neer	Sling 4 weeks + passive ROM after 1 week
Olerud et al. 2011 <i>JSES</i> [12]	3-part Neer	Sling 2 weeks + rhb
Olerud et al. 2011 <i>JSES</i> [13]	4-part Neer	Sling 2 weeks + rhb
Torrens et al. 2011 <i>JOT</i> [14]	3 and 4-part Neer	Sling 3 weeks + rhb
Yüksel et al. 2011 <i>JOT</i> [15]	3 and 4-part Neer	Velpau 2 weeks + passive ROM after 2 weeks
Boons et al. 2012 <i>Clinic. Ort</i> [16].	4-part Neer	Shoulder in mobilizer 2 weeks + rhb

Author	Complications	Consolidation
Van den Broek et al. 2007 [11] <i>Arch Orthop Trauma Surg</i>	1 patient with nonunion 10 patient with malunion at healing	92%
Olerud et al. 2011 <i>JSES</i> [12]	1 patient with nonunion 1 patient with impingement resulting from a malunited greater tubercle 2 patients with signs of minor AVN 1 patient post-traumatic osteoarthritis	96%
Olerud et al. 2011 <i>JSES</i> [13]	1 patient nonunion 1 patient without bony contact after one month was operated 3 patients with signs of AVN 5 patients post-traumatic osteoarthritis	96%
Torrens et al. 2011 <i>JOT</i> [14]	1 patient with stiffness 17 patient with malunion at healing	100%
Yüksel et al. 2011 <i>JOT</i> [15]	3 patients with nonunion 5 patients with signs of AVN	84%
Boons et al. 2012 <i>Clinic. Ort</i> [16].	2 patients had AVN of the head 3 patients had a nonunion of the four-part fracture 1 patient was operated on 13 months to hemiarthroplasty	80%

It has been noted that > 4-6 weeks of immobilization leads to more loss of shoulder range of movement whereas <2weeks of immobilization increases the risk of nonunion.

The best results as shown by Olerud et al. with conservative treatment would be to start passive exercises at 2-4 weeks and active exercises after 4 weeks. In their series, the shoulder range of motion matched that of cases that underwent internal fixation.

Multiple review publications have shown equally good outcomes with conservative or operative management of proximal humerus fractures. However, the complication rate of surgical intervention far outweigh the benefits with a re-operation rate of 30-35%, infection rate of 5 times, nerve injury of 1.5 times besides similar rates of nonunion and malunion

Variable (± SD)	Group A (Conservative) n = 20	Group B (ORIF) n = 15	p ^b
Constant-Murley Score	82.0 ± 7.6	87.0 ± 5.4	0.166
quickDASH	8.7 ± 4.3	5.4 ± 0.4	0.101
ASES Shoulder Score	83.7 ± 7.0	96.1 ± 1.0	0.003
SF-12	88.2 ± 5.9	90.1 ± 5.7	0.327
Satisfaction (1-4)	3.0 ± 0.5	3.5 ± 0.3	0.058

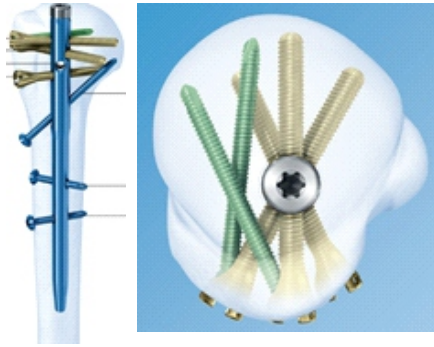
SD: Standard Deviation; ASES: American Shoulder and Elbow Surgeons; SF-12, Short Form-12; ^bboldface indicates statistical significance (p < 0.05).

So then if published literature is more in favour of conservative management, why then are the indications of surgery becoming blurred and more and more surgical interventions are being performed?

It is now well established that locking Proximal Humerus Plates, which were at one time. Considered to have all the answers for achieving good, if not excellent outcomes have now proven to have a high rate of complications. So what are the strategies that surgeons have which has added to the ever increasing number of surgeries being performed worldwide on Proximal Humerus Fractures?

First and foremost is of course Surgeons have come to realise the shortcomings of the proximal humerus locked plates and with better understanding have begun to address the deficiencies in the implants. Strategies to fill the void at the fracture site in osteoporotic fractures with bone graft (autograft/allograft/synthetic), dual plating where indicated or even replacement of the proximal humerus (Hemi-replacement Arthroplasty, reverse shoulder arthroplasty).

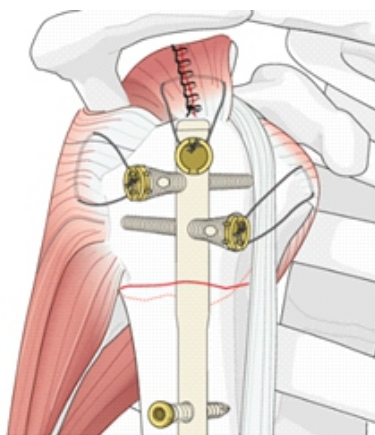
In the last decade with the improvements in the proximal humeral nail design, this implant has now become a versatile device in the management of complex humeral fractures. Following are the changes in these systems-



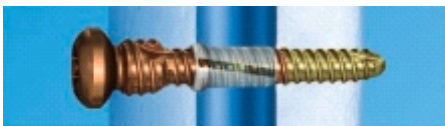
Straight nail enabling a more medial entry in line with the medullary canal

Varied and divergent proximal screw (bolt) and placement with facility for screw in screw placement.

Suture anchor points on the screw heads to secure tuberosities.



Nylon bushings to confer angular stability.



Biomechanical studies as well as clinical studies have shown better advantage over locked plates which had been the gold standard so far.

Case example



If the fracture pattern is far too comminuted, to enable fixation, hemi-arthroplasty is a very good option. The caveat here being that the rotator cuff should be intact (which most often is intact) and the tuberosities should be securely fixed to achieve good union.

The downsides of hemi-arthroplasty is that the current locally available devices are poorly designed, especially for the purpose of tuberosity fixation. The imported implants on the other hand are quite expensive, hence not within reach for a vast segment of patients.

In the western world, particularly in the USA, reverse shoulder arthroplasty is being frequently performed for complex proximal humerus fractures. According to one publication, the reverse shoulder replacement for fractures of proximal humerus has increased from 4.5% in 2001 to 67.4% in 2016. However, there are studies to suggest that the outcomes are not much better than that of conservative management.

In conclusion although the vast majority of 3 and 4 part fractures of proximal humerus do very well following conservative treatment, in active, high demand elderly patients, surgical intervention performed in a well-planned manner and executed meticulously gives very good outcomes.

New design of intramedullary nails has significant advantage and in trained hands, it has proven to give very good outcomes. In the last decade, there have been many publications from around the world reporting far superior outcomes with the newer generation Intramedullary nails for proximal humerus fractures. However meta-analysis is lacking and only time will tell whether the continued shift to operative intervention in these complex fractures is justified or conservative management is just as effective.

REFERENCES:-

1. Vandenbroek C M et al. - Arch Orthop Trauma Surg 2007
2. Olerud P et al. - J Shoulder Elb Surg 2011
3. Xie L et al. – Springerplus 2015
4. Mc Millan T et al. – Int Orthop 2018

Robotic Joint Replacement: Hype Or Hope?

Dr Vaibhav Bagaria
MBBS, MS, FCPS, Dip SICOT
Director & Head - Dept of Orthopaedics
Sir H N Reliance Foundation Hospital,
Mumbai, India

Automation and Robotics is influencing every aspect of human civilisation. The enthusiasm for newer technologies like robotics is matched with a degree of scepticism by people who believe that there is unnecessary hype regarding things that can be done conventionally. This is true even in the field of Joint Replacement where experienced surgeon say that it offers too little and is too expensive. They often argue that no clinical studies have shown any improvement in functional outcomes and survivorship in any randomised control trials or registry data. The hype surrounding this technology often stems from the futuristic appeal of robots performing complex medical procedures. However amidst this debate of Hope vs Hype, the hope lies in the potential benefits it can bring to patients in terms of precision, enhanced safety and improved outcomes.

Proponents argue that robotic assistance in joint replacement surgeries offers unparalleled accuracy. The robotic systems utilize advanced imaging and mapping technologies to create a personalized surgical plan for each patient. This level of precision can enhance the alignment and positioning of the joint implants, potentially leading to better functionality and longevity. The availability of Robotic have heralded revolution in personalised or intelligent alignment that is tailor made to patients own anatomy and suited for his or her expectations.

Enthusiasts also tout the minimally invasive nature of arthroplasty assisted by Robots. Smaller incisions, aided by the precision of robotics, can perhaps ensure reduced tissue damage, less pain, and faster recovery times. Patients average length of study reduces and they may experience a quicker return to normal activities, a significant advantage in the rehabilitation process.

However, critics often question the cost-effectiveness of these technologies and argue that the benefits may not always justify the additional expenses of these hyped up technologies. In the setting of limited improvement in functional outcomes, these questions are valid. And debate does not stop here, the questions are raised about the training opportunities and also about the learning curve for surgeons adopting robotic-assisted techniques. There is significant proportion of surgeons arguing that the human touch and experience remain irreplaceable. They also rue the fact that perhaps the younger generation who are 'Robodocs' trained only on the robot will lose ability to adopt to challenging scenarios in real life like situation.

In conclusion, while the hype around robotic joint replacement surgery is fuelled by the allure of cutting-edge technology, the hope lies in the potential improvements in precision, recovery times, procedural safety and overall patient outcomes. As research and development continue, it's crucial to strike a balance between embracing innovation and ensuring that the practical benefits for patients outweigh the hype. With newer alignment philosophies like the Intelligent alignment being adopted to achieve better forgotten knee scores and improved survivorship, the enabling technologies like Robotics will prove an indispensable tool in surgeons armamentarium. The decade top come will thus be an era neither of the man or of the machine but instead we shall witness a beautiful tango of the 'Man and the Machine'!

Fig Legend:

Fig 1: Various Robots currently available for Joint Replacement



Fig 2: Alignment philosophies changing over last few decades and the role of enabling technologies in delivering personalised intelligent alignment.

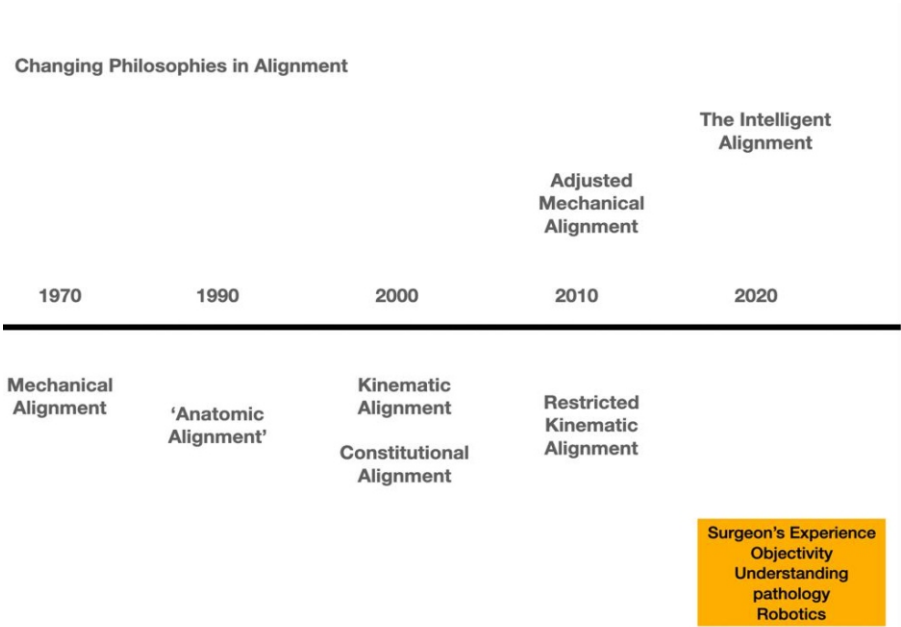


Fig 3: A case example of complex case successfully done using Robotics. Note minimal bone resection and optimal reconstruction in the case.



Humour in Orthopaedics



"You caught a virus from your computer and we had to erase your brain. I hope you've got a back-up copy!"



Humour in Orthopaedics



**"Good news.
Your cholesterol has stayed the same,
but the research findings have changed."**

**"Surgery went well, Mr Moore. I
had a lot of fun rebuilding your
knee joint."**



**"Hip replacement? He was never hip
to begin with."**