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Table of Contents

No.	Title	*Author*	Page
1	Editorial	*Gohiya A*	1-2
Original Article			
2	Comparative study of two techniques of percutaneous pinning of displaced supracondylar humerus fracture	Aher D, Mishra R K, Gohiya A.	3-7
3	A prospective study to compare efficacy of local corticosteroid and platelet rich plasma injection for treatment of lateral epicondylitis	*Yadav S S, Shekhawat Y S, Gupta S, Kirar S, Utekar R.*	8-13
4	Study of PRP assisted wound repair and regeneration in chronic non healing wounds	*Gupta A, Shrivastava S.*	14-20
5	Effects of smoking on healing of distal femur intra articular fractures, treated with distal femur locking compression plate	*Shukla R, Jain N, Jain R, Sheikh T, Baxi M.*	21-24
6	Comparative Study on Outcome of Early Aggressive and Standard Rehabilitation after Anterior Cruciate Ligament Reconstruction	*Tantuway V, Mustafa Johar S. A., Banerjee T, Narware S, Prajapati A*	25-35
7	Outcome of laminotomy and discectomy in lumbar intervertebral disc prolapse	*Singh V, Bhuyan B K, Sharma S K, Patidar A, Bisen L*	36-41
Case Report			
8	Salter-Harris type II fracture of the femoral bone in an 8-year old boy- A Case Report	*Gaur TNS, Lashkare D, Moolchandani D, Rao H, Singh S.*	42-44

Editorial

Orthopedic Education – Where we stand

Gohiya A.

India having a huge population with majority of people residing in villages with poor access to health facilities is a major challenge to health for all mission. Increase in life expectancy leading to increase in the geriatric population thus increasing the load of degenerative and fragility fracture related patients is one challenge for orthopaedicians, other challenge is epidemic road traffic accidents increasing the burden to orthopaedic surgeons [1]. To provide adequate Orthopaedic health care to Indian population we need more orthopaedician which are well equipped to cater the needs of the society. Being a resource limited country the orthopedic training and orthopedic services have to contribute to each other to improve the bone health of the nation. Every country has different medical education system so as to fulfil the medical needs specific to their inhabitants [2].

India is having a poor doctor patient ratio which is even worse for orthopaedic care providers and most doctors are concentrated in the city areas, making the ratio very poor in villages where the majority of Indian population resides. Primary care physician or first contact physician in rural and sub urban areas is generally a MBBS graduate or an alternative medicine practitioner who is not adequately trained in identifying and providing primary care in common orthopaedic emergencies. In places where trained personnel are available the problem is of having optimal infrastructure to provide required care. The standard treatment guidelines for management of common orthopaedic ailments is not existing in India. The lack of proper referral system makes the scene worse making the health care system inefficient due to overload at tertiary care centres.

When it comes to care provided by the orthopaedic specialists for one condition the care provided is not uniform throughout different parts of the country. Orthopaedic training is not customised as per our need.

It was noted long back that there has been a considerable decline in standard of knowledge, particularly the basic sciences, namely anatomy, embryology, physiology, pathology, and genetic engineering which are alternatively going to play vital role in development of speciality [3]. The postgraduate training in India is not comprehensive enough and some graduates may have insufficient training to practice independently [4].

In India there is one death every 4 minutes due to road traffic accidents, for every death there are 30 severe and 50 minor injury patients [5]. Primary care physician encounters trauma more than any other condition. Making orthopaedics a major subject in MBBS training program and providing practical training during internship can improve the level of care. During post graduate courses inclination of students and teaching faculty is towards super speciality like spine arthroscopy, arthroplasty and at the end of course students are incompetent to independently take care of common traumatic, infective, neoplastic, degenerative and deficiency diseases [6]. The post graduate curriculum needs to be revised and focussed on the immediate needs of the society. The imparted training and assessment test should be uniform throughout the country to ensure standardised orthopaedic care to whole society.

Current literature is full of evidences for management of almost all clinical conditions which are prevalent in western world, in contrast the scarcity of literature for conditions endemic in India pose a decision-making problem. Proper training during postgraduate training to perform a quality research for the conditions which are endemic in our country can make a difference. Developing research instinct in all trainees is highly desirable [7]. All the improvements in the orthopaedic training are not possible without having a brigade of trained competent medical

teachers justifying the need for a structured and mandatory faculty development program [8].

We have lots of advantages, huge number of patients which we have, makes us capable of making guidelines for the orthopedic practices in the developing countries. This is possible by introducing mandatory research to the institutions and encouragement, incentives to the researchers. We need to sensitize and convince policy makers to implement the desired actions to improve orthopaedic education and in turn the patient care for our society.

References

1. Jain AK. Orthopedic services and training at a crossroads in developing countries. Indian J Orthop. 2007;41:177–9.
2. Anil Kumar Jain. Current state of orthopedic education in India. Indian J Orthop. 2016 Jul-Aug; 50(4): 341–344.
3. Sankaran B. Education in orthopaedics: Is it going up or down. Indian J Orthop. 2003;37:1
4. Dougherty PJ, Sethi A, Jain AK. Orthopaedic surgery education in India. Clin Orthop Relat Res. 2014;472:410–4.
5. BMUS: The burden of musculoskeletal diseases. [Last accessed on 2016 June 29]. http://www.boneandjointburden.org/
6. Sarmento A. Sub-specialization in orthopaedics. Has it been all for the better? J Bone Joint Surg Am. 2003;85:369–73
7. Jain AK. Teaching-learning: An integral component of sound patient care. Indian J Orthop. 2008;42:239–40.
8. Tuli SM. The art and science of orthopaedics in developing countries. J Bone Joint Surg Br. 1985;67:840–2.

Original Article

Comparative study of two techniques of percutaneous pinning of displaced supracondylar humerus fracture

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Abstract

Background: supracondylar fractures of the humerus are very common fractures in paediatric age groups. If displaced, preferred treatment is close reduction with percutaneous K-wire fixation. This study compares the functional outcome of cross K-wires Vs lateral K-wires in Gartland type III supracondylar humerus fractures in paediatric age groups

Methods: 60 cases of supracondylar fractures of the humerus Gartland type III in children operated with closed reduction and pinning of which 30 were of lateral and 30 were of cross K wire groups from January 2015 to June 2017 with minimum 4 months follow-up period were included.

Results: Functional outcome of the patients was assessed by Flynn's criteria. Results were excellent 13.33 %, good 40% fair 46.6% in cross K wire group and excellent 6.6 %, good 46.6%, fair 40% and poor 6.6 % in lateral K wire group.

Conclusion: Both lateral entry pin fixation and crossed pin fixation are effective in the treatment of Gartland type III extension supracondylar fractures of the humerus in children.

Keywords: Cross k wires, Lateral pinning, Gartland type III Supracondylar fracture humerus.

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Introduction

Supracondylar Humerus Fracture is most common fracture around elbow in pediatric age group. Supracondylar Humerus Fracture has an incidence of 50-70 %, of which extension type is about 98 % and flexion type about 2% [1].

Supracondylar Humerus Fracture can be managed by both non-operative or operative treatment. The decision to operate depends upon the fracture type and stability after reduction. For undisplaced fractures, plaster suffices, but for displaced fractures, fixation with K-wire is preferred [2].

Available treatment options for displaced supracondylar humerus fracture (Gartland Type 3) are Closed reduction and percutaneous pinning or Open reduction and K wire Fixation [3].

Loss of reduction and subsequent malunion is generally seen when type III fractures are treated in plaster, which led to percutaneous pinning as preferred option [4]. There are various techniques of percutaneous pinning with literature supporting one over the other based on biomechanical advantages shown in vitro. This study is aimed to compare functional outcomes and complications between two techniques (crossed pinning Vs lateral pinning) of percutaneous pining of displaced Supracondylar Humerus Fracture in pediatric age group.

Materials and Methods

This was a prospective, randomized study conducted in the Department of Orthopaedics and traumatology at Gandhi Medical College and Hamidia hospital Bhopal from January 2015 to June 2017. Total 60 patients with 30 patients each in cross k wires and lateral pinning group were observed.

Inclusion Criteria

1. Age 2 - 12 years
2. Presenting within 1 week of injury
3. Closed fractures
4. Gartland Type-III supracondylar fracture

Exclusion Criteria

1. Open fractures
2. Floating elbow injuries
3. Previous fracture in the same elbow.

All patients with Supracondylar fracture humerus reporting to emergency department of Hamidia hospital were evaluated by thorough clinico-radiological examination. Patients who fulfilled the inclusion criteria and whose parents gave the consent to be registered in study, were enrolled in the study as per the detailed proforma. Patients were allocated to one of the groups (Crossed pins Vs Two Lateral Pins) with the help of computer-generated random table. Type lll supracondylar humerus fracture were posted in operation theatre as early as possible after work-up. Under appropriate anesthesia patient was positioned supine on the operating table, affected limb scrubbed, painted and draped. Limb was placed over the sterile draped C-arm image intensifier. Initially, closed manipulation was performed with linear traction and flexion of elbow, pushing the distal fragment anteriorly. Assessment of reduction was done under image intensifier in both AP and Lateral views. Following that fixation by one of the two techniques was done depending on the randomization.

In crossed pinning technique, lateral pin was inserted first and medial pin was placed with the elbow in less flexion to avoid ulnar nerve injury. In two lateral pin technique two divergent K-wires were passed from the lateral condyle. After leaving about 2 cm of the pins outside the skin, pins were bent and cut off and well-padded posterior above elbow slab was applied with elbow flexed to 90° or less. The Neurovascular status was again assessed post operatively.

The slab and K wires were removed after 4 weeks, and range of motion exercises and physiotherapy were started. Thus, the patient was followed up at 1-month, 2-month, 4 month, 6 months and final follow-up at 12 months. The functional outcome was assessed by Flynn's criteria [5]. The results were graded as excellent, good, fair or poor according to the range of motion and loss of carrying angle. Complications if any, were also noted.

Results

The average age was 7 years (range 2-12 years) with a peak incidence in 5-8 years. 40 patients were having Left side and 20 patients were having right side fracture. Fall on outstretched hand contributed to about 96% cases. In 60 % cases, Postero-medial displacement of distal fragment was seen. The average follow-up duration for patients was of 6 months. Radiological union was seen on an average in 5 weeks. Loss of Baumann's angle of 5° was seen in 33% lateral pinning cases and in 20% cross k wires cases. Loss of Baumann's angle of 2° was seen in 33% lateral pinning cases and in 30% cross k wires cases.

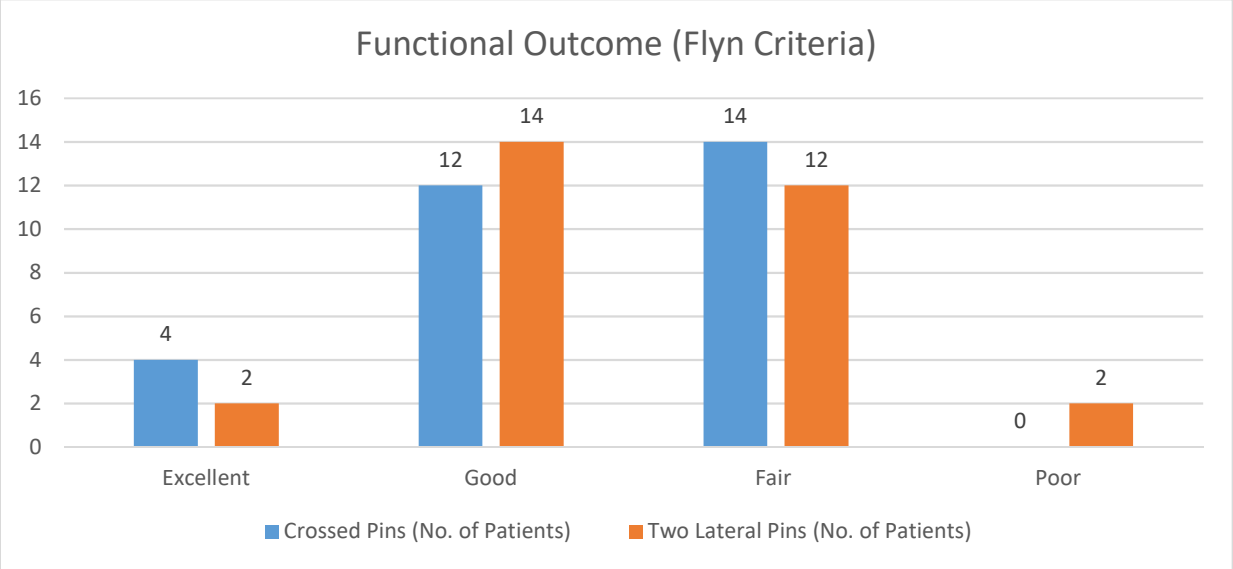

Figure 1: Functional Outcome of two groups

Mean carrying angle loss was 3^0 in lateral K wire group and 2^0 in cross K wire group, which was statistically significant($p<0.05$). This loss of carrying angle was more in lateral group probably due to less stable construct. Loss of range of motion was 10° in cross k wires group and 11° in lateral pinning group, which was not statistically significant.

In this study, no pin tract infection was noted, no ulnar nerve was injured. Loss of reduction was seen more in lateral wire group but eventually all achieved radiological union with < 5^0 angulation. The difference in functional outcome between the two groups was not statistically significant (P=0.69).

Discussion

Fracture that occurs at supracondylar area or metaphysis of distal humerus is labelled as Supracondylar Fracture. For closed reduction and percutaneous pinning, two configuration of K-wires exists either lateral pinning or cross K-wires. In this study, the average age was 7 years (range 2-12 years) with peak incidence in 5-8 years. Other authors reported similar age groups, average age 7 years by Ramsey and Griz [6], 6.4 years by Nacht et al [7].

In this study, there were 90% male, Fowles and Kassab reported 89% [8] and Nacht et al 50% male preponderance [7].

In this study, left sided fractures were more than right sided fractures. Fowles and Kassab showed left (57%) more involved than right [8]. Similar results were seen in study by Nacht et al (55%) [7].

In this study, fall on outstretched hand (96%) was the most common mode of injury, similar findings were shown by Mostafavi and Bhuyan [9,10].

In our study, the average radiological union was seen in 5 weeks (range 3 to 9 weeks). Sudheendra et al reported average radiological union at 7.6 weeks [4] Rijal and Pandey reported radiological union in 6 weeks [11].

In our study, Cross k wires had better stability. Lee SS et al and Zioutset al reported that medial and lateral entry provides greater torsional rigidity than lateral entry pin fixation does [12,13]. Sudheendra et al. in their study noted 82% excellent results and 18% good results in cross k wires case and 71% excellent results and 29% good results in lateral pinning case [4]. Raffi c et al. in their study found 72% excellent results and 28% good results with

lateral pinning [14]. Khan obtained 88% excellent, 4% good and 4% poor results in his study [15]. In our series, the functional outcome following cross k wires was excellent in 13.33%, good in 40% of cases, fair 46.6 % and poor in 0 % and lateral pinning showed 6.6 % excellent ,46.6% good results, 40 % fair with 6.6 % poor results. The difference in functional outcome between the two groups was not statistically significant (P=0.69).

No ulnar nerve palsy occurred in our study. Skaggs et al. found no ulnar nerve palsy and no reduction was lost in 124 children managed with only lateral-entry pins [16]. Skaggs et al. noted the incidence of ulnar nerve injury as 4% in patients whom the pins were applied without hyper flexion of the elbow and as 15% in whom the medial pin was applied with the elbow hyper flexed [17]. The rate of ulnar nerve injuries varies in different studies. Lyons et al. have reported this number as 6%, Royce et al. as 3%, Agus et al. as 58% [18,19,20]. No Pin tract infection occurred in our series. In the series by Mostafavi and Sperothe incidence of pin tract infection was 5% [9]. The incidence of infection was 2% in Pirone et al. which was found more compared to our study [21].

No pin migration or significant loss of reduction was seen in our study. Gordon observed pin migration in 6% of cases and Lee noticed the loss of reduction in 7% of cases. [22,12]

Conclusion

Cross K wire or lateral K wire, both are similar in effect for the final functional outcome with no significant difference for treatment of Gartland type III supracondylar humerus fracture in pediatric age group, although taking into consideration the ulnar nerve injury, lateral k wire technique has an upper hand, but at the cost of slight loss of reduction. However, it depends upon the surgeon's practice and preference which may negate these complications. Hence, in our study, we found lateral k wire and cross k wire equally good in terms of safety and efficacy, but stability is more in cross wires.

References

1. Babal JC, Mehlman CT, Klein G. Nerve injuries associated with pediatric supracondylar humeral fractures: A meta-analysis. J PediatrOrthop 2010;30:253-63.
2. Yadav UB, Singhal R, Tonk G, Aggarwal T, Verma AN. Crossed pin fixation in displaced supracondylar humerus fractures in children. Indian J Orthop 2004;38:166-9.
3. Mazda K, Boggione C, Fitoussi F, Penneçot GF. Systematic pinning of displaced extension-type supracondylar fractures of the humerus in children. A prospective study of 116 consecutive patients. J Bone Joint Surg Br 2001;83:888-93.
4. Sudheendra PR, Nazareth EL. A comparative study of outcome of percutaneous lateral and crossed pinning in the treatment of type III supracondylar fractures of humerus in children. Sch J Appl Med Sci 2014;23:959-62.
5. Attenborough CG. Remodeling of the humerus after supracondylar fractures in childhood. J Bone Joint Surg Br 1953;35:386-95.
6. Ramsey RH, Griz J. Immediate open reduction and internal fixation of severely displaced supracondylar fractures of the humerus in children. Clin OrthopRelat Res 1973;131-2.
7. Nacht JL, Ecker ML, Chung SM, Lotke PA, Das M. Supracondylar fractures of the humerus in children treated by closed reduction and percutaneous pinning. ClinOrthopRelat Res 1983;203-9.
8. Fowles JV, Kassab MT. Displaced supracondylar fractures of the elbow in children. A report on the fixation of extension and flexion fractures by two lateralpercutaneous pins. J Bone Joint Surg Br 1974;56:490-500.
9. Mostafavi HR, Spero C. Crossed pin fixation of displaced supracondylar humerus fractures in children. ClinOrthopRelat Res 2000;56-61.
10. Bhuyan BK. Close reduction and percutaneous pinning in displaced supracondylar humerus fractures in children. J ClinOrthop Trauma 2012;3:89-93.

11. Rijal KP, Pandey BK. Supracondylar extension type III fractures of humerus in children: Percutaneous cross-pinning. Kathmandu Univ Med J 2006;4:465-9.
12. Lee SS, Mahar AT, Miesen D, Newton PO. Displaced paediatric Supracondylar humerus fractures: Biomechanical analysis of percutaneous pinning techniques. J Pediatr Orthop. 2002;22:440–3.
13. Zionts LE, McKellop HA, Hathaway R. Torsional strength of pin configurations used to fix Supracondylar fractures of the humerus in children. J Bone Joint Surg Am. 1994;76:253–6.
14. Raffi c M, MuhammedFazil VV. Percutaneous K-wire fixation of supracondylar fractures in children. J Evid Based Med Healthc 2014;1:2349-562.
15. Khan AQ, Goel S, Abbas M, Sherwani MK. Percutaneous K wiring for Gartland type III Supracondylar humerus fractures in children. Saudi Med J. 2007;28:603–6.
16. Skaggs DL, Cluck MW, Mostofi A, Flynn JM, Kay RM. Lateral-entry pin fixation in the management of Supracondylar fractures of humerus in children. J Bone Joint Surg Am. 2004;86:702–7.
17. Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT. Operative treatment of Supracondylar fractures of humerus in children. The consequences of pin placement. J Bone Joint Surg Am. 2001;83:735–40.
18. Lyons JP, Ashley E, Hoffer MM. Ulnar nerve palsies after percutaneous cross-pinning of Supracondylar fractures in children's elbows. J Pediatr Orthop. 1998;18:43–5.
19. Royce RO, Dutkowsky JP, Kasser JR, Rand FR. Neurologic complications after K-wire fixation of Supracondylar humerus fractures in children. J Pediatr Orthop. 1991;11:191–4.
20. Agus H, Kelenderer O, Kayali C. Closed reduction and percutaneous pinning results in children with Supracondylar humerus fractures. Acta Orthop Traumatol Turc. 1999;33:18–22.
21. Pirone AM, Graham HK, Krajbich JI. Management of displaced extension-type supracondylar fractures of the humerus in children. J Bone Joint Surg Am 1988;70:641-50. Of percutaneous pin fixation in displaced supracondylar fractures of the humerus in children. J OrthopSurg (Hong Kong) 2004;12:76-82.
22. Gordon JE, Patton CM, Luhmann SJ, Bassett GS, Schoenecker PL. Fracture stability after pinning of displaced Supracondylar fractures of humerus in children. J Pediatr Orthop. 2001;21:313–8

Original Article

A prospective study to compare efficacy of local corticosteroid and platelet rich plasma injection for treatment of lateral epicondylitis

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Abstract

Background: Several modalities of management are available for lateral epicondylitis which is a common cause of pain around elbow. Corticosteroid for long time remained gold standard treatment of choice but Studies have suggested the use of platelet rich plasma (PRP) as a safe and effective choice of therapy. Purpose of this study was to evaluate the efficacy of autologous PRP vs steroid injection in treatment of chronic lateral epicondylitis.

Methods: It was a Randomized control trial of 60 cases with at least 6 months of symptoms. PRP was prepared from 40 ml autologous venous blood by double centrifugation method. Patients were followed up to 6 months. All patients had a baseline assessment including Visual Analogue Scale (VAS) and Disability assessment of Shoulder and Hand score (DASH).

Results: Mean age of patients was 36.5 and 38.3 years for PRP and Corticosteroid group respectively. Success was defined as reduction of pain (VAS) without re-intervention after a follow up of 6 months. Steroid treatment showed better outcome in short term and PRP showed better outcome in long term. Both VAS and DASH score showed significant progressive improvement with no complications with PRP whereas with steroid injection there was recurrence of symptoms after 3 months.

Conclusion: Treatment of patients with Lateral Epicondylitis with PRP decreases pain and significantly increases function, even after a follow-up of 6 months.

Keywords: PRP; Corticosteroid; Tennis elbow; VAS; DASH

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Introduction

Lateral epicondylitis, or “tennis elbow,” is a frequently diagnosed condition and a common cause of pain around elbow joint. The complaint is characterized by pain over the lateral epicondyle of the humerus, which is aggravated with resisted dorsiflexion of the wrist. The incidence is approximately 4 to 7 per 1000 patients per year [1].

Lesion can be in common extensor tendon, extensor Carpi radialis brevis (ECRB), or radial collateral ligament but most commonly extensor Carpi radialis brevis (ECRB) is involved [1]. Repeated tendon overuse leads to micro tear in tendon when stretch exceeds physiological limit of the tissue. There is ongoing inflammatory process besides change in complex tendon structure. Generation of pain may be due to irritation of mechanoreceptors by traction or shear forces or activation of nociceptive

receptors by neurotransmitters such as substance P [2].

Several modalities of treatment have been developed which includes rest, nonsteroidal anti-inflammatory drugs, physical therapy, tennis elbow belt, corticosteroid injection, botulinum toxin injection, Extracorporeal shock wave and pulsed ultrasound. One of these treatments is injection of platelet-rich plasma (PRP) which is an autologous blood product enriched with biological factors responsible for tissue regeneration.

Corticosteroid work as short-term measure by reducing the inflammation but it doesn't deal with the root cause of inflammation as PRP does.

The use of platelets as vehicles for the delivery of growth factors in the form of platelet rich plasma (PRP) may be just the beginning of a new medical frontier known as ''orthobiologics.'' Since 1992 Platelet-rich plasma (PRP) is a new technology focused on enhancing the healing response after injury of different tissue types [3].

Platelet rich plasma is defined as the plasma fraction of autologous blood having a platelet concentration above baseline. Study has shown clinical efficacy of PRP use with minimum concentration of platelets by four times as compare to autologous blood [4].

As PRP is an autologous blood product, it is free of transmissible diseases and cannot cause hypersensitivity reactions. The healing properties of PRP have been attributed to the various biological growth factors like platelet derived growth factor (PDGF), vascular endothelial growth factor (VEGF), epidermal growth factor, hepatocyte growth factor (HGF) and insulin like growth factor-1[5].

PRP is prepared through a platelet separation process, which results in an increased platelet concentration compared with the original whole blood sample [6]. It is assumed that when PRP is injected into an area of tendinopathy, the platelets release a multitude of growth factors and stimulate a healing response and many investigators found increased collagen gene expression and increased production of VEGF and HGF in human tenocytes treated with PRP [7].

Materials and Methods

This randomized control trial for evaluating efficacy of platelet rich plasma vs. corticosteroid injection in treatment of Lateral Epicondylitis was conducted in Department of Orthopaedics Gajra Raja Medical College and Jayarogya group of Hospital, Gwalior, Madhya Pradesh.

All patients of "chronic tennis elbow" with at least 6-month duration of symptoms who came to OPD of Department of Orthopaedics were included in the study.

Total 60 diagnosed cases of tennis elbow on the basis of clinical examination who met the inclusion criteria were randomized into two groups (PRP and corticosteroid group).

PRP preparation was done from 40 ml of autologous venous blood. Blood was centrifuged at two levels, first 1200 rpm for 10 minutes and second at 2000 rpm for 10 minutes. Patients are analyzed for pain using VAS score and functional assessment done using DASH score.

Inclusion criteria: patients having age between 20 to 70 years and duration of symptoms at least 6 months.

Exclusion criteria: Patients who did not give consent for the procedure, patients with tendon rupture, acute inflammatory disease, infectious disease, malignancy, history of autoimmune platelet disorder, history of consistent use of NSAIDS and systemic steroid use, anemic patients, patients having platelet count less than 150,000 per micro liter, diabetic and pregnant woman.

2 ml of PRP solution (diluted with plasma) injected directly into the area of maximum tenderness using a 22-g needle into the common extensor tendon using a peppering technique. This technique involved a single skin portal and then 5 penetrations of the tendon. Patients in steroid group received 2 ml of methylprednisolone (40 mg/ml, inj).

Immediately after the injection, the patients were kept in a supine position without moving the arm for 15 minutes. Patients were sent home with instructions to limit their use of the arm for approximately 24 hours and use acetaminophen for pain. A formal stretching and strengthening exercises of forearm muscles were initiated on 2nd day after injection. At 4 weeks after the procedure, patients are allowed to proceed with normal sporting or recreational activities as tolerated. The patients were assessed using Visual analogue scale (VAS), Disability assessment of Shoulder and Hand score (DASH) score before and after treatment at 2, 8 weeks and 3, 6 months.

Results

Total 60 patients were included in study (30 in each group), demographically both groups were similar (Table 1). Mean VAS Score (Figure 1) and DASH score (Figure 2) before treatment and at each follow-up were compared (total 5 mean and 2 groups). There was statistically significant difference between both groups in all 5 means except at 2nd and 3rd mean (2, 8 weeks respectively).

Age (Years)	PRP Group	Corticosteroid Group	Total
21 – 24	1	0	1
25 – 29	1	2	3
30 – 34	7	8	15
35 – 39	14	12	26
40 – 44	5	4	9
45 – 50	2	4	6
51 – 54	0	0	0
55 – 60	0	0	0
Total	30	30	60

Table 1: Demographic Data of Both Groups

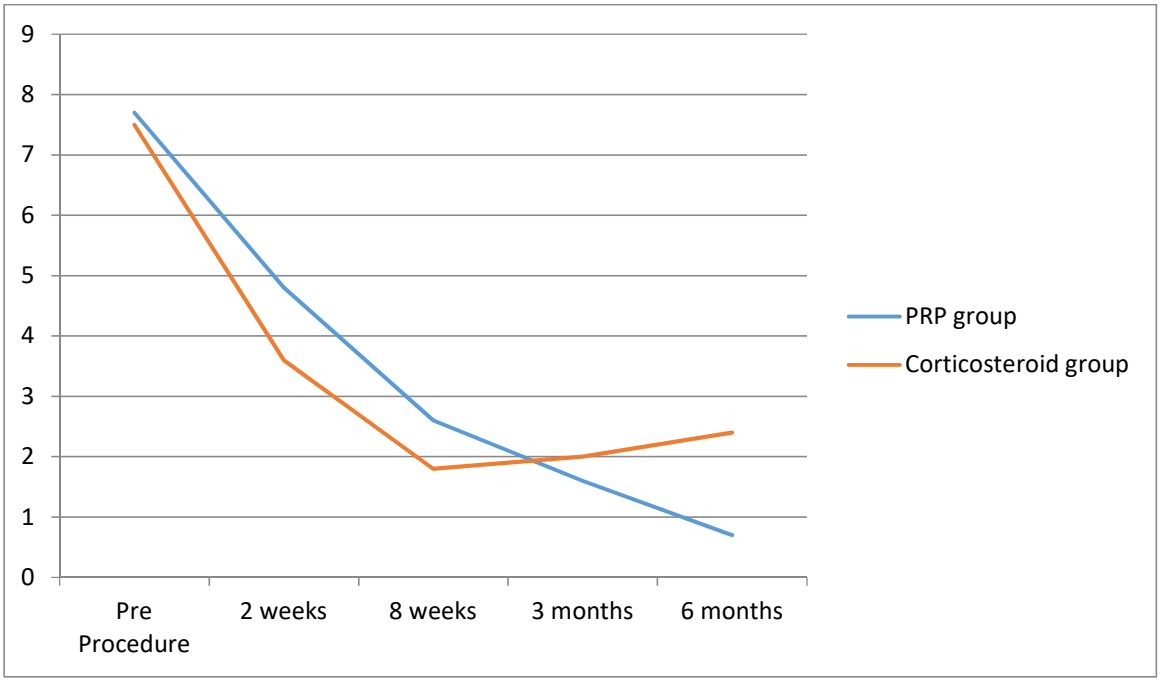

Figure 1: Mean VAS score (PRP vs. Corticosteroid group)

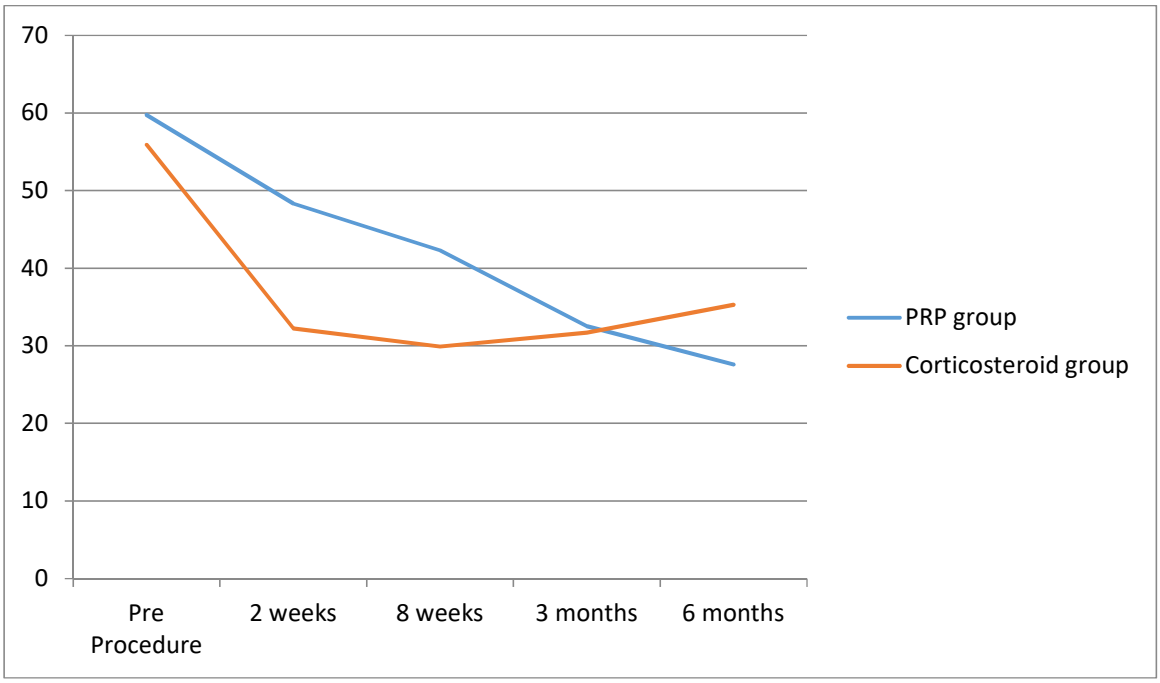

Figure 2: Mean DASH score (PRP vs. Corticosteroid group)

Discussion

This Randomized single blind study was designed and conducted to compare the use of autologous PRP to Local corticosteroid in patients with lateral epicondylitis. Lateral epicondylitis is one of the most perplexing disorder of musculoskeletal system with many possible options of treatment. Most common etiological factors are repeated dorsiflexion or pronation and supination movements. The number of overuse injuries is not exactly known, but in sports medicine, they account for 30 to 50% of all injuries [8]. Studies have shown that people who have worked for 25 to 35 years are more likely to develop tendinopathy [9]. In our study maximum patients were in fourth decade. The mean age group was 36.5 and 38.3 years in PRP and Corticosteroid group respectively. Nirschl RP et al in their study found tennis elbow predominance in fourth and fifth decade [10]. In our study female predominance was present 60 % and 66 % in PRP and corticosteroid group respectively. Karen Walker-Bone et al in their study on occupation and epicondylitis found mean age 45.6 years (range 24.6 - 66.3 years) with 55

% of subjects being female who are involved in repetitive forearm movements [11].

Nirschl et al found mainly fibro-elastic tissue and vascular invasion describing this condition as “angiofibroblastic tendinosis” [12]. The corticosteroid group was improved progressively & than declined while PRP group got progressively improved. After 6 months of follow up the effect in PRP group was maintained and declined in Corticosteroid group. This concludes that PRP is more helpful in treating lateral epicondylitis.

Corticosteroid injection which was gold standard treatment for lateral epicondylitis, is considered controversial now a days because studies have proved that it offers only short-term relief as compare to physiotherapy and wait and watch policy [13, 14]. Often results are poor after 3 months of follow-up, there is higher

occurrence of relapse probably because steroid leads to permanent changes within microstructure of tendon as patient has tendency to overuse the arm after injection as a result of direct pain relief [15].

Platelet rich plasma is an ideal biologic product in which patients own platelets are collected into a highly concentrated form. Platelets release more than 95% of the pre-synthesized growth factors within one hour of activation. This initial burst is followed by steady synthesis and secretion of growth factors for their remaining life span [16]. No activation agent was used during our procedure, as platelets get activated in vivo when exposed to thrombin which in turn produced in response to injection of platelets using a peppering technique and exposed collagen also acts as a natural activator of platelets [17]. There is concern regarding use of bovine thrombin as activator, being an exogenous substance, it can produce detrimental effects and collagen is naturally involved in clotting cascade and is attractive alternative to bovine thrombin.

Use of leukocyte rich or leukocyte depleted PRP is a topic of debate, presence of leukocyte in PRP augments its antibacterial activity and have ability to debride the tendon and start healing (as leukocytes also contains growth factors). Presence of matrix metalloproteinase (released from neutrophils) have detrimental effects on tissue healing but this fact needs to be proved by Randomized control trials. Injection of autologous Platelets has been shown to improve repair in tendinosis in animal studies [17,18,19].

Effect of single injection PRP last for 1 year whereas percentage of success rate for corticosteroid injection drops from 51 % to 40 % after 2 years of follow-up [17].

As far as relief of pain is concerned corticosteroid offer better short-term relief as compare to longer term relief offered by PRP injection. Same clinical efficacy is seen with respect to improvement of function assessed by DASH scores. Improvement in DASH Scores were better in corticosteroid group for short term and for longer term in PRP group and these results are consistent with other studies [20,21, 22].

Conclusion

In treatment of lateral epicondylitis local injection of corticosteroid gives better but short-term pain relief where as local PRP injection offers reasonable and long-term pain relief with no recurrence of symptoms and better functional outcomes.

However, a long-term follow-up study with large sample size is advocated to substantiate these findings.

References

1. Cyriax JH. The pathology and treatment of tennis elbow. J Bone and Joint Surg 1936 Oct;18(4):921-940.
2. Scott A, Khan KM, Roberts CR, Cook JL, Duronio V. What do we mean by the term “inflammation”? A contemporary basic science update for sports medicine. Br J Sports Med 2004 Jun 1; 38(3):372-380.
3. Emilo Lopez Vidriero, Krista A. Goulding, David A. Simon, Mikel Sanchez and Donald H. Johnson. The Use of Platelet-Rich Plasma in Arthroscopy and Sports Medicine: Optimizing the Healing Environment. The Journal of Arthroscopic and Related Surgery 2010; Vol 26, No 2 (February): 269-278.
4. Anitua E, Andia I, Sanchez M, Azofra J, del Mar Zalduendo M, de la Fuente M, Nurden P, Nurden AT. Autologous preparations rich in growth factors promote proliferation and induce VEGF and HGF production by human tendon cells in culture. J Orthop Res 2005 Mar;23(2):281-286.
5. De Mos M, van Windt AE, Jahr H, van Schie HT, Weinans H, Verhaar JA, Van Osch GJ. Can platelet rich plasma enhance tendon repair: a cell culture study. Am J Sports Med 2008 Jun;36(6):1171-1178.

6. Eppley B, Woodell JE, Higgins J. Platelet quantification and growth factor analysis from platelet-rich plasma: Implications for wound healing. Plast Reconstr Surg 2004;114:1502-1508.
7. Sampson S, Gerhardt M, Mandelbaum B. Platelet rich plasma injection grafts musculoskeletal injuries: A review. Curr Rev Musculoskelet Med 2008;1:165-174.
8. Scott, A. And Ashe, M.C.(2006) Common tendinopathies in the upper and lower extremities. Current Sports Medicine Reports 5,233-241.
9. Forde, M.S., Punnett, L. and Wegman, H.. (2005) Prevalence of musculoskeletal disorders in union ironworkers. Journal of Occupational and Environmental Hygiene 2, 203-212.
10. Nirschl RP et al Elbow tendinopathy: Tennis elbow, clin sports Med. 2003 oct(4) : 813-36.
11. Karen Walker-Bone, Keith T Palmer and Cyrus Cooper: Occupation and Epicondylitis: A population-based study, Rheumatology (Oxford).2012 Feb. ;51(2) :305-310.
12. Nirschl RP, Ashman ES. Tennis elbow tendinosis (epicondylitis). Instr Course Lect. 2004;53:587–98.
13. Marx RE, Carlson ER, Eichstaedt RM, Schimmele SR, Strauss JE, Georgeff KR. Platelet-rich plasma: growth factor enhancement for bone grafts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998 Jun;85(6):638-646.
14. Molloy T, Wang Y, Murrell GA. The roles of growth factors in tendon and ligament healing. Sports Med 2003 Apr 1; 33(5):381-394.
15. Murray MM, Forsythe B, Chen F, Lee SJ, Yoo JJ, Atala A, Steinert A. The effect of thrombin on ACL fibroblast interactions with collagen hydrogels. J Orthop Res 2006 Mar;24(3):508-515.
16. Marx RE. Platelet-rich plasma: evidence to support its use. J Oral Maxillofac Surg. 2004;62:489–96.
17. Peerbooms JC, Sluimer J, Bruijn DJ, Gosens T. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. Am J Sports Med 2010 Feb;38(2):255-262.
18. Wong SM, Hui AC, Tong PY, Poon DW, Yu E, Wong LK. Treatment of lateral epicondylitis with botulinum toxin: a randomized, double-blind, placebo-controlled trial. Ann Intern Med 2005 Dec 6;143(11):793-797.
19. Boushel R, Langberg H, Green S, Skovgaard D, Bülow J, Kjar M. Blood flow and oxygenation in peritendinous tissue and calf muscle during dynamic exercise in humans. J Physiol 2000 Apr 1;524(Pt 1):305-313.
20. Mishra A, Pavelko T. Treatment of chronic elbow tendinosis with buffered platelet-rich plasma. Am J Sports Med. 2006;34(11):1774-78.
21. Gosens T, Peerbooms JC, van Laar W, den Oudsten BL. Ongoing positive effects of plate-rich plasma versus corticosteroid injection in lateral epicondylitis: A double-blind randomized controlled trial with 2-year follow up. Am J Sports Med. 2011;39(6):1200-08.
22. Omar AS, Ibrahim ME, Ahmed AS, Said M. Local injection of autologous platelet rich plasma and corticosteroid in treatment of lateral epicondylitis and plantar fasciitis: Randomized clinical trial. The Egyptian Rheumatologist. 2012;34:43–49.

Original Article

Study of PRP assisted wound repair and regeneration in chronic non healing wounds

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Abstract

Background: Chronic non healing wounds are a cause of severe pain and disability in a large number of patients. Usually these patients are suffering from conditions which has lowered their capacity to heal the wound because of variety of systemic, metabolic or local disturbances in milieu interior. Some of the commonest types of these non-healing wounds are vascular ulcers, diabetic ulcers and pressure ulcers. The usual strategy to treat these ulcers like TIME strategy is not always sufficient and some wounds remain unresponsive to current therapies. Platelet rich plasma (PRP) is a rich source of complex group of growth factors essential for natural wound repair. PRP therapy was used in current study to assess its role in healing of chronic wounds.

Methods: The present study was carried out in 35 patients of various age and sex groups. All these patients had chronic non healing wounds which had not responded to conventional therapy. Wound size was measured at the initiation of protocol by graph method. PRP was prepared using standard two spin technique. The PRP so prepared was injected in the periphery of the wound as per STARS protocol every fourth day. Saline dressings were done regularly and no antiseptics or antibiotics were used. No analgesics were given. Wound size was determined at every fourth day at the time of injection using graph method. **Results:** Out of 35 wounds, 30 wounds healed completely within 40 days of starting therapy. In none of the cases antibiotics or wound debridement was required. Of the remaining 05 wounds there was a significant reduction in size, pain and infection.

Conclusion: PRP injection for treatment of chronic non-healing wounds is an effective method of treatment irrespective of their etiology

Keywords: Non healing ulcer, wound care, PRP injections, STARS protocol

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Introduction

Right from the days of Sushruta in Ancient India, due to frequent battles and wars, healing of wounds was a matter of concern [1] Sushruta Samhita has two separate chapters dealing with healing of these wounds, and describes more than 100 plants for treatment of wounds both singly and in combination [2] Sushruta has mentioned not only procedures and drugs to obtain a clean wound (VranaShodan) followed by healing (VranaRopan) but also medicines to help treatment of keloids [3].

Chronic wounds can be classified into vascular ulcers (eg, venous and arterial ulcers), diabetic ulcers, and pressure ulcers. Some common features shared by each of these include a prolonged or excessive inflammatory phase [4,5]. Persistent infections, formation of drug-resistant microbial biofilms, and the inability of dermal

and/or epidermal cells to respond to reparative stimuli [6].

Pressure ulcers develop as a result of prolonged unrelieved pressure and shearing force applied to skin and the underlying muscle tissue leading to a decrease in oxygen tension, ischemic injury, and tissue necrosis. Pressure ulcers are common in patients with compromised mobility and decreased sensory perception (neuropathies) [7,8].

The phenotypic abnormalities of epidermis- and dermis-derived cells residing in chronic wounds include lower density of growth factor receptors and lower mitogenic potential preventing them from responding properly to environmental cues. For instance, fibroblasts, isolated from patients with chronic diabetic, chronic nondiabetic wounds, or patients with venous insufficiency, have lower mitogenic response to PDGF-AB, IGF, bFGF, and epidermal growth factor applied separately or in combination. These findings are likely due to a decrease in receptor density [9, 10, 11].

Successful treatment of a particular chronic wound requires a detailed understanding of the molecular and cellular components present within each wound bed. Currently, chronic (and acute) wounds of different etiologies are treated using a multistep approach based on contemporary knowledge of wound healing and known by the acronym TIME. First, nonviable tissues (T) from within and around a wound are removed using surgical debridement or debriding agents, such as bacterial Collagenase, Papain, Bromelin etc. Second, infection and inflammation (I) are minimized with antibiotics and anti-inflammatory preparations. Next, moisture (M) imbalance is corrected, generally with carefully selected dressings. Finally, epithelialization (E) and granulation tissue formation are promoted by the application of specific therapies, such as growth factors [12].

The use of TIME strategy is not always sufficient, however, and some wounds remain nonresponsive to current therapies.

Platelet and platelet rich plasma

A rich source of the complex group of growth factors (GF's) essential to natural wound repair is the platelet [13]. The platelets act in the hemostasis; wound healing and re-epithelialization liberating diverse growth factors that stimulate the angiogenesis, promoting growth and vascular fibroblast proliferation that in turn provide an increase in the collagen synthesis [14,15].

Platelet rich plasma (PRP) therapy has accumulated considerable attention over the two last decades, mainly due to its potential ability in regenerative medicine, including oral and maxillofacial surgery, sports and veterinary medicine. Platelets as a main components of the PRP, contain more than 1100 different proteins, with numerous post-translational modifications, resulting in over 1500 protein-based bioactive factors [16, 17, 18]. These factors include immune system messengers, growth factors, enzymes and their inhibitors and other factors which can participate in tissue repair and wound healing. Another important characteristic of PRP is that represents an autologous product, which is prepared from the patient`s own blood. Therefore, the use of autologous PRP eliminates any concerns about the risk of crossed contamination, disease transmission or immune reactions [19, 20, 21].

Materials and Methods

Study Design: Prospective Interventional Randomized Control Study.
Sample Size: 34 consecutive patients with chronic (more than 90 days duration) wounds of varying etiology and depth were taken up for the study.

Method: These patients were thoroughly evaluated. The study group patients were subjected to wound infiltration of autologous inactivated PRP prepared by double spin technique as per the standard protocol, using 20-40 ml of patient's blood as per the size of the wound, using a 22 gauge needle under strict asepsis. This will be done on the day of recruitment and subsequently every 4th day till the wound has reached the size of less than 100 sq. mm. These patients were dressed with moist saline dressing only. No antibiotics were used as far as possible. Similarly, analgesics were avoided. No surgical intervention was done once the patient was enrolled.

Method of preparing PRP

It was done with a double spin method, using 20ml of venous autologous blood, freshly drawn from the patient. 5ml blood was then transferred to 4 EDTA test tubes each and centrifuged at 2000 RPM for 15 minutes. RBCs got settled in lower portion of test tube and plasma in the upper part. Plasma was extracted and collected in a separate test tube and re-centrifuged at 1200 RPM for 10 minutes. The plasma further separated into upper buffy coat with platelet poor plasma and lower 3-4 ml layer containing platelet rich plasma.

STARS THERAPY PROTOCOL [22]

The autologous PRP thus obtained is transferred to a 10 ml syringe and locally infiltrated into wound margins through a 22 gauge needle at a distance of approximately 1cm. The process is repeated every 4th day. Local moist saline dressing is performed on alternate days. Diluted cetrimide and chlorhexidine gluconate solution are used for cleaning dirty wounds. No further surgical interventions were undertaken.

Inclusion Criteria

1. All age and genders

2. Wound of the size at least 100 square mm.

3. All chronic wounds (more than 90 days) including trophic ulcers, decubitus ulcers, diabetic and venous ulcers.

Exclusion criteria

1. Wound size less than 100 square mm in area.

2. Wounds less than 90 days duration.

3. Patient on I/V antibiotics.

4. patient with serious systemic illness and moribund patients

Results

The results of the study were as follows

Table: 01

Distribution of patients according to size of wound at start of treatment

Size (cm)	Number	Percentage
1 – 10	9	25.71
11 – 100	22	62.86
> 100	4	11.43
Total	**35**	**100%**

Table: 02

Distribution of patients according to rate of healing of wound

Rate of Healing	20 days	40 days	60 days
50±5% reduction	25	8	2
Complete healing	2	12	16

5 patients did not show complete healing even at the end of 60 days. However, 4 of them had significant reduction in size of wound while 1 did not show significant healing.

Table: 03

Distribution of patients according to Pain scoring and initial assessment for pain

VAS score	At start of therapy		4th day of therapy		20th day of therapy		40th day of therapy	
	No.	%	No.	%	No.	%	No.	%
1-2	19	54.29	31	88.57	29	93.55	9	90
3-4	7	20	2	5.71	0	0	0	0
5-6	3	8.57	2	5.71	0	0	0	0
7-8	6	17.14	0	0	0	0	0	0
9-10	0	0	0	0	2	6.45	1	10
Total	**35**	**100**	**35**	**100**	**31**	**100**	**10**	**100**

Table 4

Distribution of patients according to infection

Infection	Number	Percentage
Start	12	34.29
4th Day	4	11.43
20th day	0	0
40th day	0	0
Total	**16**	

Discussion

Non healing wounds has been a cause of concern to mankind since time immemorial. Not only they cause significant morbidity and suffering, but the treatment is prolonged and expensive. Further in spite of all modern modalities of treatment, a large number of these wounds fail to heal. A variety of growth factors and cytokines have been discovered in last 4 decades which promote rapid wound healing.

Shrivastava et al in their protocol STAR therapy have advocated direct injection of platelet rich plasma into the wound instead of making gel preparation with good results. The STAR protocol in our study was found tobe simple, rapid, early reproducible, with use of minimal equipment and inexpensive [22].

We had used autologous blood for PRP preparation, and therefore none of our patient had any adverse reaction.

There are large number of studies in the published literature are on chronic non healing wounds like trophic ulcers of leprosy, diabetic foot ulcers, chronic lower limb ulcers etc. but with mix results.

In the present study, we have studied chronic wounds sustained because of variety of reasons being treated with PRP alone without use of analgesics and antibiotics, no debridement and moist saline dressings only. Chronic wounds were classified as per center for medical services definition [23].

Graph paper tracing was used to record the size of the wound. More than 71.43% of patients showed 50% + 5% reduction in the size of the wound with in 5 infiltration and 90% wounds reached 50% + 5% size with in 10 infiltrations i.e. in 40 days. However complete healing took much long time. The larger was the surface area of the wound, the longer it took to heal. More than 90% of cases healed with in 40 days (20 infiltrations).

One of the patient had a non healing ulcer over the sole of the foot which was of about 7 years duration. Using the present protocol with only 10 infiltrations the patient showed complete healing. Not only the STARS protocol of PRP therapy brought about the complete healing but this healing left behind minimal scar which was of good quality and unlikely to breakdown in near future. Further, as the amount of scaring was minimal there were no secondary deformities because of scar contraction. Similarly a patients with non healing ulcers over both ankles of over 10 year duration showed complete healing.

One of the most remarkable things was the quality of wound healing in these cases. The healed area shows much less scarring. Whatever scar was left behind was of good quality and unlikely to breakdown in future. Even skin showed remarkable regeneration.

In a study by Manish Suthal et al, the potential safety and efficacy of autologous platelet rich plasma for treatment of non-healing ulcers was demonstrated [24]. These wounds were initially treated by standard methods of wound care including skin grafting and other method of skin cover and reconstructive surgery and pain management with management of comorbidities, but satisfactory healing could not be achieved. In the trial, they gave a single subcutaneous injection of PRP along with one PRP gel dressing for each ulcer. They observed ulcer healing as early as 4 weeks PRP treatment and the mean healing time was on to be almost 8.2 weeks. They also noted reduction of discharge and pain reduction was noted within first week post treatment.

In present series, the pain was assessed using VAS scoring. At the start of therapy the VAS score was between 7-8 in 17.14% cases, 8.6% between 5 and 6, 20% had a VAS score between 3 and 4 and 54.29% showed score of 1-2.

This score decreased rapidly after infiltrations and on 4th day of infiltrations there was a significant shift of patients with 88.57% showing VAS score of 1-2 and 5.71% showing VAS score of 3-4. The number of patients showing VAS score of 5 -6 was 5.71%. As almost all of these patients had not received analgesics, this signifies a very positive effect of PRP infiltration.

In only one patient with chronic wounds over ankles of more than 10 years duration, the VAS score was 8 at the start of the treatment and this further increased to 9. Though the wound healed with infiltrations, the pain persisted and the patient had to undertake separate intervention for control of pain. The cause of this pain was ill understood and may be related to nerve entrapment in the scar and altered perception because of chronic problem.

Pain relief had dramatic effect on patient outcome, they became more cooperative, happier, and demand for analgesics were almost absent.

Kathelene M. Lacci have postulated that PRP may suppress cytokine release and thus inflammation leading to decrease in pain [25].

Marissa J Cartier et al found that PRP wound therapy may positively impact the patient by reducing pain [26].

In none of the patient, oral or systemic antibiotic were given. However, most of

these patients were on antibiotics before the start of protocol, which were stopped. At the start of study, 34.29% of patients had positive culture of wound, which decrease to 11.43% by 3rd infiltration and complete eradication of infection by 5th infiltration. None of the patient showed increased clinical signs of infection and there were no complication related to infection. The wound cultures showed a growth of variety of bacteria including MRSA, pseudomonas and E. coli. Usually, these were present as individual infecting organisms.

Marrisa J Cartier et al in their meta-analysis found that superficial and deep infections and postoperative complications were significantly lower in PRP treated subjects than in control group. Further, infection was significantly increase in control group than in PRP group [26].

In this series during the whole course of study, there was no significant complication. Some patients experienced pain of injection which was not severe and subsided immediately after the procedure.

One patient had severe pain to start with (VAS score 8). This patient had long standing ulcers over both ankles. The pain increased after infiltration and persisted throughout the course of treatment.

Overall, it was found that PRP infiltrations not only helped in wound healing but also significantly promoted skin regeneration leading to minimization of scar formation and its resulting problems.

Conclusion

Autologous PRP could be easily prepared and used, utilizing minimal instrumentation even at centers with limited resources. The STARS protocol of preparing and infiltrating PRP in the wound margin was easy and effective irrespective of their etiology with minimal complications.

References

1. Buchanan EP; Longaker MT; Lorenz HP, Fetal skin wound healing. AdvClin Chem. 2009; 48:137-61
2. Katherine E. Degen and Robert G. Gourdie, Embryonic Wound Healing: A Primer for Engineering Novel Therapies for Tissue Repair, VC 2012 Wiley Periodicals, Inc. Birth Defects Research (Part C) 96:258–270 (2012)
3. Dobaczewski M, Gonzalez-Quesada C, Frangogiannis NG. The extracellular matrix as a modulator of the inflammatory and reparative response following myocardial infarction. J Mol Cell Cardiol. 2010 Mar; 48(3):504-11.
4. Bertalanffy FD. Comparison of mitotic rates in normal renewing and neoplastic cell populations. Proc Can Cancer Conf. 1967; 7():65-83.
5. Anandan V, Jameela WA, Saraswathy P, Sarankumar S. Platelet Rich Plasma: Efficacy in Treating Trophic Ulcers in Leprosy. J ClinDiagn Res. 2016 Oct;10(10):WC06-WC09.
6. Sussman C. Wound care: A collaborative practice manual for physical therapists and nurses. Gaithersburg: Aspen; 2001. Wound measurements. In: Sussman C, Bates-Jensen B, editors; pp. 120–41.
7. Bonham PA. Assessment and management of patients with venous, arterial, and diabetic/neuropathic lower extremity wounds. AACN Clin Issues. 2003 Nov; 14(4):442-56; quiz 548-50.
8. Defloor T. The risk of pressure sores: a conceptual scheme. J ClinNurs. 1999 Mar; 8(2):206-16.
9. Loot MA, Kenter SB, Au FL, et al. Fibroblasts derived from chronic diabetic ulcers differ in their response to stimulation with EGF, IGF-I, bFGF and PDGF-AB compared to controls. Eur J Cell Biol. 2002;81:153–60.
10. Seidman C, Raffetto JD, Marien B, Kroon C, Seah CC, Menzoian JO. bFGF-induced alterations in cellular markers of senescence in growth-rescued fibroblasts from chronic venous ulcer and venous reflux patients. Ann Vasc Surg. 2003;17:239–44.
11. Vasquez R, Marien BJ, Gram C, Goodwin DG, Menzoian JO, Raffetto JD. Proliferative capacity of venous ulcer wound fibroblasts in the presence of platelet-derived growth factor. Vasc Endovascular Surg. 2004;38:355–60.
12. Schultz GS, Sibbald RG, Falanga V, Ayello EA, Dowsett C, Harding K, Romanelli M, Stacey MC,

Teot L, Vanscheidt W. Wound bed preparation: a systematic approach to wound management. Wound Repair Regen. 2003 Mar; 11 Suppl 1():S1-28.
13. Dugrillon A, Kluter H. Current use of platelet concentrates for topical application in tissue repair. TherTransfus Med. 2002;29:67-70.
14. Robson MC. The role of growth factors in the healing of chronic wounds. Wound Rep Regenerat. 1997;5:12-7.
15. Marx RE. Platelet-rich plasma: evidence to support its use. J Oral Maxillofacial Surg. 2004;62:489-96.
16. Boswell SG, Cole BJ, Sundman EA, Karas V, Fortier LA. Platelet-rich plasma: a milieu of bioactive factors. Arthroscopy. 2012 Mar; 28(3):429-39.
17. Marques LF, Stessuk T, Camargo IC, Sabeh Junior N, dos Santos L, Ribeiro-Paes JT. Platelet-rich plasma (PRP): methodological aspects and clinical applications. Platelets. 2015; 26(2):101-13.
18. Knezevic NN, Candido KD, Desai R, Kaye AD. Is Platelet-Rich Plasma a Future Therapy in Pain Management? Med Clin North Am. 2016 Jan; 100(1):199-217.
19. Ygberg S, Nilsson A. The developing immune system - from foetus to toddler. ActaPaediatr. 2012 Feb; 101(2):120-7
20. Whitby DJ, Ferguson MW. Immunohistochemical localization of growth factors in fetal wound healing. Dev Biol. 1991 Sep; 147(1):207-15.
21. Leung A, Crombleholme TM, Keswani SG. Fetal wound healing: implications for minimal scar formation. CurrOpinPediatr. 2012 Jun; 24(3):371-8.
22. Shrivastava S, Singh PK, Taywade S. STARS therapy: "Sandeep's technique for assisted regeneration of skin". J Orthop Allied Sci 2016;4:5-7.
23. Mangran AJ, Horan TC, Pearson ML et al. The hospital infection control adivsory committee. Guideline for prevention of surgical site infection 1999. Infect Control Hospital Epidemiol 1999;20(4):258-278.
24. Suthar, M., Gupta, S., Bukhari, S., &Ponemone, V. (2017). Treatment of chronic non-healing ulcers using autologous platelet rich plasma: a case series. Journal of Biomedical Science, 24, 16. http://doi.org/10.1186/s12929-017-0324-1
25. Kathleen M Lacci. Yale J Biol Med 2010 Mar;83(1):9-9.
26. Majaeske, Cheryl (1992). Rehabilitation of wound: Surface area measurements. Physical Therapy. 72:138-41.

Original Article

Effects of smoking on healing of distal femur intra articular fractures, treated with distal femur locking compression plate

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Abstract

Background: The aim of this study was to identify the effect of smoking on bone healing and other complications encountered in treatment and follow up of distal femur fracture.

Methods: A total of 54 patients with AO type B and C Distal femur fracture were included during the study period. All the patients were treated with distal locking compression plating. Functional outcome was recorded on the basis of American knee society scoring system.

Results: The mean radiological union time and incidence of post-operative infection was significantly higher in smoker as compared to non-smokers. Total American knee society score was similar in both the groups.

Conclusion: Smoking affects the fracture union in distal femur fracture patients. Smokers have more infection rate and more stiffness compared to non- smokers. It is recommended to stop smoking during fracture treatment.

Keywords: Distal Femur Locking Compression plate, Fracture, Union time, Smoking

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Introduction

Distal femur fracture constitutes a heterogeneous group of injuries affecting knee and accounts for approximately 7% of all femoral fracture [1]. Distal femoral fracture can be caused by any high or low energy trauma. High energy trauma are mainly associated with road traffic accidents and occur in younger patients while low energy traumas are due to sudden fall in house and occur in osteoporotic bones of elder patients.

Effective ways of managing most distal femoral fractures are anatomical reduction of the articular surface, restoration of limb alignment, and early mobilization. However the treatment of distal femur articular fracture is still a challenge for the surgeons as long term disability can occur in patients with extensive articular cartilage damage, marked bone comminution and severe soft tissue injury [2]. Moreover intra-articular step ≥3 mm may lead to osteoarthritis [3].

With the conversion of shearing forces into compressive forces at the screw bone interface; anatomically contoured locking plate system reduces the load experienced at the implant [4,5]. Locking plates provides an additional advantage of angular stability of locked screws by which applied load is evenly distributed amongst the component screws and avoids significant load concentration at a single screw bone interface [4,6,7]. This leads to the overall

fixation strength of the locked plate system, equaling the sum of fixation strengths of all screw bone interfaces instead of that of a single component screw as in conventional plating [8].

Voluminous literature [8-10] is available showing good to excellent results of locking plates for the treatment of distal femur fracture however none of study has compared the outcome of patients in smoker and nonsmoker. Since smoking affects the bone union time therefore this study was carried out to assess the long term functional outcome of distal femur fracture treated with locking plates and compared the outcome results among smokers and nonsmokers.

Materials and Methods

A total of 54 patients of distal femur AO type B and C were recruited for the study during 2013 to 2016. Patients with skeletally immature individuals, unfit for surgery any other associated fractures/ head injury open fractures were excluded from the study.

All the fractures were treated with definitive open reduction and internal fixation (ORIF) within 3 days. Patients were positioned supine on radiolucent table. Depending on the fracture classification, a standardized direct lateral and/or medial approach was used for the reduction of intra-articular fragments. After temporary fixation of articular fragments using screws, K-wires, or clamps the locking plate was placed and fixed temporarily using K-wires. The placement of the plate and reduction of the fracture was confirmed under intra operative image intensifier control. Patient was immobilized for 48 hours after removal of drain and progressive range of motion was allowed as per tolerance. Full range of motion was allowed after suture removal. Static and dynamic quadriceps was encouraged throughout the day as far as possible. Partial weight bearing (PWB) was allowed after 6 weeks and full weight bearing was allowed on the basis of radiological evidence during follow up. Patients with radiographic evidence of delayed union, were given functional brace for support and allowed PWB.

Patients were followed up at the end 6 weeks, 3, 6 months, 1 year and every 6 months up to 4 year. Functional outcome of patients were recorded as per American knee society score on each visit. Radiological union was defined as bridging of three of the four cortices and disappearance of the fracture line on the plain radiographs for a patient who was able to bear full weight.

A person was called smoker who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes as per NHIS Guidelines [12].

Statistical analysis was done using MedCalc Software (Trial Version). Patients were divided into two groups depending upon the smoking status. Mann Whitney U test was applied to see the significant difference in median of scores in two groups. Chi Square test was applied to see the difference in frequency of discrete variables in two groups.

Results

The mean age of patients was 43.72±16.0 years. High and low energy fracture was observed in 29 and 25 patients respectively. 45(83.3%) patients show the good (AKSS 70-79) to excellent (AKSS≥80) outcome in terms of American Knee Society score. One patient showed the poor results (AKSS< 60) whereas 8 patients had fairly acceptable results.

Out of 54 studied subjects 22 were classified as smoker and 32 were as non-smoker. We found no significant difference in median of Pain, range of flexion, stability, flexion contraction and extension lag and total American knee society score among the two groups. However, smokers have

significantly delayed radiological union time (median 16 weeks, Range 12-24 weeks) as compared to non-smokers (median 12 weeks, range 12-20 weeks). Incidence of infection was also observed higher in smokers (27.3%) as compared to non-smokers (6.2%) (P= 0.033).

Discussion

The present study shows the efficacy of Distal Locking Compression plate in the treatment of Distal Femur fracture. The mean radiological union time was 14.56±3.37 weeks in non-smokers and 16.73±3.6 weeks in smokers. Malik et al [3], Schandelmeir et al[13] and Mackmiller et al[14] reported full radiological union at 13.88, 14.3 and 13.8 weeks respectfully. Smokers have delayed radiological union time of distal femur fracture treated with locking plate. Hernigou et al[15] studies the 114 subjects with femur, humerus or tibia fracture and shows that smokers have a higher risk of developing a nonunion after a diaphyseal fracture, whether open or closed. The deleterious effects of smoking on bone healing were also reported in fractures other than femur [16-18]. However Giannoudis et al shows that smoking was not a statistically significant factor for nonunion of the femoral diaphysis[19]. Schenker et al in 2013 [20] conducted a meta- analysis on 18 papers and shows that odds of nonunion was 2.3 times in the smoking group compared to the non-smoking group.

Norepinephrine is released from adrenergic axon terminals within the tissues of smokers. [21] Oxygen perfusion in the subcutaneous affected tissue declines rapidly and remains low for 30 to 50 minutes[22]. Following smoking inhibition of vascular endothelial growth Factor (VEGF) - induced tube formation occurs, leading to negative effect of smoking on endothelial function and vessel growth and ultimately results in delayed or non-union of the fracture [23].

We observed higher knee stiffness and infection in smoker groups. Similar to our study Castillo et al [24] showed that infection rate was twice in smokers, as compared to non-smokers ($p<0.05$). Adams [25] shows that more patients in smoking group required bone grafting to stimulate union as compared to nonsmokers. Schenker et al [20] shows no difference in post-operative superficial and deep infections between smokers and non-smokers undergoing long bone fracture surgery.

There are certain limitations of the study. We did not analyze the effect of duration and smoking pack size on the radiological union time and other complications. Secondly the sample size is too small to make any conclusive result.

Further studies on other type of fracture should also be conducted in future to see the effect of smoking on bone union.

Conclusion

Smoking affects the fracture union in distal femur fracture patients. Smokers have more infection rate and more stiffness compared to non- smokers. It is recommended to stop smoking during fracture treatment .

References

1. Arneson TJ, Melton LJ, Lewallen DG. Epidemiology of diaphyseal and distal femoral fractures in Rochester, Minnesota, 1965 Clin Orthop Relat Res. 1988;234:188-94.
2. Schatzker J. Fractures of distal femur revisited. Clin Orthop Relat Res 1998; 347 : 43-56
3. Malik I, Khan R, Khurana R, Sharma S. Comparative study of management of distal femoral fractures managed by dynamic condylar screw and distal femoral locking compression plate. Webmed Central ORTHOPAEDICS 2015;6(9):WMC004976.
4. Egol KA, Kubiak EN, Fulkerson E, Kummer FJ, Koval KJ. Biomechanics of locked plates and screws. J Orthop Trauma. 2004;18:488–93

5. Gardner MJ, Helfet DL, Lorich DG. Has locked plating completely replaced conventional plating? Am J Orthop (Belle Mead NJ) 2004;33:439–46.
6. Gardner MJ, Brophy RH, Campbell D, Mahajan A, Wright TM, Helfet DL, et al. The mechanical behavior of locking compression plates compared with dynamic compression plates in a cadaver radius model. J Orthop Trauma. 2005;19:597–603.
7. Cordey J, Borgeaud M, Perren SM. Force transfer between the plate and the bone: Relative importance of the bending stiffness of the screws friction between plate and bone. Injury. 2000;31(Suppl 3):C21–8.
8. Singh AK, Rastogi A, Singh V. Biomechanical comparison of dynamic condylar screw and locking compression plate fixation in unstable distal femoral fractures: An in vitro study. Indian J Orthop. 2013;47(6):615-20.
9. Pakuła G, Kwiatkowski K, Kuczmera P, Fudalej P. Assessment of Outcomes of Treatment of Fractures of Distal Femur with a Locking Plate Taking into Account Factors Influencing the Result. Ortop Traumatol Rehabil. 2015;17(5):501-11.
10. Henderson CE, Kuhl LL, Fitzpatrick DC, Marsh JL. Locking plates for distal femur fractures: is there a problem with fracture healing? J Orthop Trauma. 2011; Suppl 1:S8-14.
11. Trivedi NP, Chauhan RH, Padhiyar DR, Gandhi PS. Outcome of fracture of intra articular distal femur treated with distal femur locking compression plate. Int J Res Orthop. 2015 Dec;1(1):22-27
12. Schandelmaier P. Distal femoral fractures and LISS stabilization. Injury Int Care Injured. 2009; 32 S-C : 55-63.
13. Markmiller M konard G and Sudkamp N. femur-LISS and Distal Femoral Nail for fixation of distal femoral fractures. Clin Orthop 2004; 426:252-7.
14. Hernigou J, Schuind F. Smoking as a predictor of negative outcome in diaphyseal fracture healing. Int Orthop. 2013;37(5):883-7.
15. Castillo RC, Bosse MJ, MacKenzie EJ, Patterson BM. Impact of smoking on fracture healing and risk of complications in limb threatening open tibia fractures. J Orthop Trauma 2005; 19(3):151–157
16. Harvey EJ, Agel J, Selznick HS, Chapman JR, Henley MB. Deleterious effect of smoking on healing of open tibia-shaft fractures. Am J Orthop 2002;31(9):518–521
17. Hoogendoorn JM, van der Werken C. The adverse effects of smoking on healing of open tibial fractures. Ned Tijdschr Geneeskd 2002; 146(35):1640–1644
18. Giannoudis PV, MacDonald DA, Matthews SJ, et al. Nonunion of the femoral diaphysis: the influence of reaming and non-steroidal anti-inflammatory drugs. J Bone Joint Surg [Br] 2000;82-B:655–658.
19. Schenker ML, Scolaro JA, Yannascoli SM, Baldwin KD, Mehta S, Ahn J. Blowing Smoke: A Meta Analysis of Smoking on Fracture Healing and Post Operative Infection. 2013 American Academy of Orthopaedic Surgeons annual meeting in Chicago.
20. Cryer PE, Haymond MW, Santiago JV, Shah SD Norepinephrine and epinephrine release and adrenergic mediation of smoking-associated hemodynamic and metabolic events. N Engl J Med 1976 ; 295 : 573-577.
21. Jensen JA, Goodson WH, Hopf HW, Hunt TK. Cigarette smoking decreases tissue oxygen. Arch Surg 1991 ; 126 : 1131-1134.
22. Michaud SE, Dussault S, Groleau J, Haddad P, Rivard A. Cigarette smoke exposure impairs vegFinduced endothelial cell migration : role of nO and reactive oxygen species. J Mol Cell Cardiol 2006 ; 41 : 275-284.
23. Castillo RC1, Bosse MJ, MacKenzie EJ, Patterson BM; LEAP Study Group. Impact of smoking on fracture healing and risk of complications in limb-threatening open tibia fractures. J Orthop Trauma. 2005 Mar;19(3):151-7.
24. Adams CI, Keating JF, Court-Brown CM. Cigarette smoking and open tibial fractures. Injury 2001; 32(1):61–65.

Original Article

Comparative Study on Outcome of Early Aggressive and Standard Rehabilitation after Anterior Cruciate Ligament Reconstruction

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Abstract

Background: Anterior cruciate ligament rupture is one of the most common debilitating knee injuries that can result in significant functional impairment. Although ACL reconstruction (ACL-R) is a commonly practiced surgical intervention, controversy still lingers with regard to graft selection and rehabilitation protocol, both of which are largely influenced by surgeon preference. The post-operative restrictions are largely based on the theory of graft and fixation vulnerability, with concerns related to compromising the biological healing process of the reconstructed graft during the first 12 weeks postoperatively. To date, controversy still lingers in evaluating the effects that aggressive rehabilitation has on clinical outcomes with semitendinosus graft. The aim of this study was to investigate whether immediate full weight bearing combined with aggressive rehabilitation in ACL-R significantly altered postoperative outcome over one year, relative to a program that included partial weight bearing and standard rehabilitation protocol in the immediate post-operative period.

Methods: The study was a prospective randomized clinical trial, with all patients being recruited by a single senior orthopedic surgeon at our institute after a confirmed diagnosis of an isolated ACL rupture by clinical examination and magnetic resonance imaging. Seventy patients were enrolled in the study from June 2015 to August 2017. Informed consent was taken. Clearance from ethical committee of the institute was taken. Patients were evaluated pre operatively and post operatively at the end of 1, 3, 6 months and 1 year for outcomes.

Results: In this prospective study conducted with seventy patients, we found better results in group 2 (full weight bearing) as compared to group 2 (partial weight bearing) in terms of IKDC scoring, range of motion (ROM), ROM difference from opposite knee and fixed flexion deformity. The results were statistically significant.

Conclusion: We conclude that aggressive rehabilitation to be superior to standard rehabilitation after isolated ACL-R using STG .

.**Keywords**: ACL, ACL-R, Rehabilitation

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Introduction

Anterior cruciate ligament rupture is one of the most common debilitating knee injuries that can result in significant functional impairment.[1-3] Surgical reconstruction of a ruptured ACL is advocated as the treatment of choice, particularly for individuals who intend to resume competitive sporting activities[4-6]. Although ACL reconstruction (ACL-R) is a commonly practiced surgical intervention, controversy still lingers in

regard to graft selection and rehabilitation protocol, both of which are largely influenced by surgeon preference [7]. Traditional postoperative restrictions such as bracing for immobilization, delayed weight bearing, and limiting early hyperextension motion (beyond 0° of extension) have all been used throughout rehabilitation in hopes of preventing excessive loads on the healing graft [8]. The implications of these restrictions are largely based on the theory of graft and fixation vulnerability, with concerns related to compromising the biological healing process of the reconstructed graft during the first 12 weeks postoperatively [9-11]. These concerns have most appropriately been justified for Semitendinosus (ST) grafts due to the slower incorporation rate of the soft tissue into the bone tunnel and concerns of excessive graft-tunnel motion leading to increased laxity [12]. Granted that these theories are still valid concerns in postoperative management, advancements in surgical technique and fixation have warranted re-evaluation of the use of restrictions after ACL-R with gathering evidence showing that restrictions may not be necessary. Early aggressive rehabilitation has shown no adverse effects with respect to future injury rate, Antero-Posterior laxity, Range Of Motion deficits, or ability to return patients back to their previous level of function [12,13]. Although a significant body of literature has shown that aggressive rehabilitation defined as early unrestricted motion, immediate weight bearing, and eliminating the use of immobilizing braces to be appropriate after ACL-R using BPTB grafts conclusions are unclear when evaluating the effects of early aggressive rehabilitation on ST autografts [13-15]. To date, controversy still lingers in evaluating the effects that aggressive rehabilitation has on clinical outcomes with this particular graft. Some studies have shown that aggressive rehabilitation immediately after surgery tends to increase knee laxity [8,10], while others have found no difference in subjective outcomes or functional stability [16,17]. Furthermore, Wright et al conducted a systematic review confirming that the available evidence on postoperative bracing, immediate weight bearing, and unrestricted ROM has largely been performed addressing BPTB grafts, demonstrating the lack of attention in comparison with ST grafts [14]. Therefore, a need exists to evaluate the effects of early aggressive rehabilitation of ST grafts on mobility, strength, and self-reported outcome scores. The aim of this study was to investigate whether immediate full weight bearing combined with aggressive rehabilitation in ACL-R significantly altered postoperative outcome over one year, relative to a program that included partial weight bearing and standard rehabilitation protocol in the immediate post-operative period.

Materials and Methods

Seventy patients were enrolled in the study from June 2015 to August 2017. The study was a prospective randomized clinical trial, with all patients being recruited by a single senior orthopedic surgeon at our institute after a confirmed diagnosis of an isolated ACL rupture by clinical examination and magnetic resonance imaging. Two experienced physical therapists who were not involved in data collection treated all patients in both allocated groups. A single research assistant who was blinded to the treatment allocation measured all outcome variables. Patients were evaluated pre operatively and post operatively at the end of 1, 3, 6 months and 1 year for outcomes.

Inclusion criteria:

•Age 18 to 55 years

•Grade II or III isolated ACL tear confirmed by orthopedic surgeon

•Demonstration of full knee extension and at least 85% knee flexion preoperatively compared with the contralateral knee

•Ability to comply with a 24-week rehabilitation program.

•Unilateral pathology

•No previous knee surgery

Exclusion criteria:

•Any previous ACL-R to either knee

•Concurrent injury to the posterior cruciate ligament

•Grade III tear of either (medial or lateral) collateral ligament

•Meniscus tears ≥5 mm or meniscus repairs

•Pregnancy

•Neurological disorders (multiple sclerosis, cerebral palsy, etc) affecting participation

Patients with age above 50 years were excluded as age related degenerative changes are common after 50 years. After subjects provided consent for participation, the research assistant randomized them into one of two treatment groups by computer software randomization. A simple randomization technique was performed, and to conceal the treatment allocation, the randomization scheme was computer generated before initiation of the study. Patients were randomized into either the aggressive or the nonaggressive group.

Surgical Procedure

All patients underwent a single-bundle ipsilateral 4-strand ST autograft reconstruction. Confirmation of a complete ACL tear was accomplished arthroscopically, followed by preparation of the femoral notch and tibial footprint. The STGs were harvested in standard fashion through a 3-cm incision over the anteromedial tibia, then the graft was prepared with #5 Ethibond whip stitching the free ends of the graft. A tibial tunnel was reamed entering the anatomic center of the tibial ACL insertion. An accessory medial portal was created through which the femoral tunnel was placed in the anatomic center of the femoral ACL footprint. The tibial and femoral tunnels were sized to the diameter of the graft. The ACL fixation consisted of femoral button suspension fixation. Tibial fixation was accomplished using an interference screw with the knee positioned in 15° knee flexion with force applied as in doing posterior drawer test.

Rehabilitation

The aggressive group underwent a protocol that was largely derived from previous work described by Biggs et al 18 (Figure 1). Patients were not required to wear a postoperative knee brace and began exercises to restore full passive motion without restrictions on hyperextension immediately after surgery. Patients in this group were informed to begin weight bearing as tolerated immediately after surgery and to only use the bilateral axillary crutches for comfort. During the first postoperative week, patients underwent a rehabilitation regimen consisting of keeping activity to a minimum and remaining in a supine position while the leg was elevated at least 12 inches above the chest for at least 18 hours of the day, and beginning phase I exercises to initiate early motion and muscle activation. The nonaggressive group were required to wear a ROM brace locked at 20° of flexion for the first week and unlocked 10° to 100° for an additional 3 weeks after surgery. Patients were instructed to only remove the brace to perform the phase I exercises, and during physical therapy visits. They were required to wear the brace at night to sleep for the first week. After 4 weeks of postoperative bracing, the brace was discontinued and the treating physical therapists instructed patients to begin full passive knee-flexion motion, but they were restricted to no hyperextension stretching for

an additional 2 weeks postoperatively. Hyperextension exercises were defined as any active or passive stretch beyond 0° of knee extension. Patients in this group also used bilateral axillary crutches for 2 weeks postoperatively at 25% weight bearing for the first week and 50% weight bearing for the second week. During the first postoperative week, they underwent the same rehabilitation regimen as the aggressive group. All patients performed a standard postoperative physical therapy protocol, and compliance was tracked through weekly logbook entry.

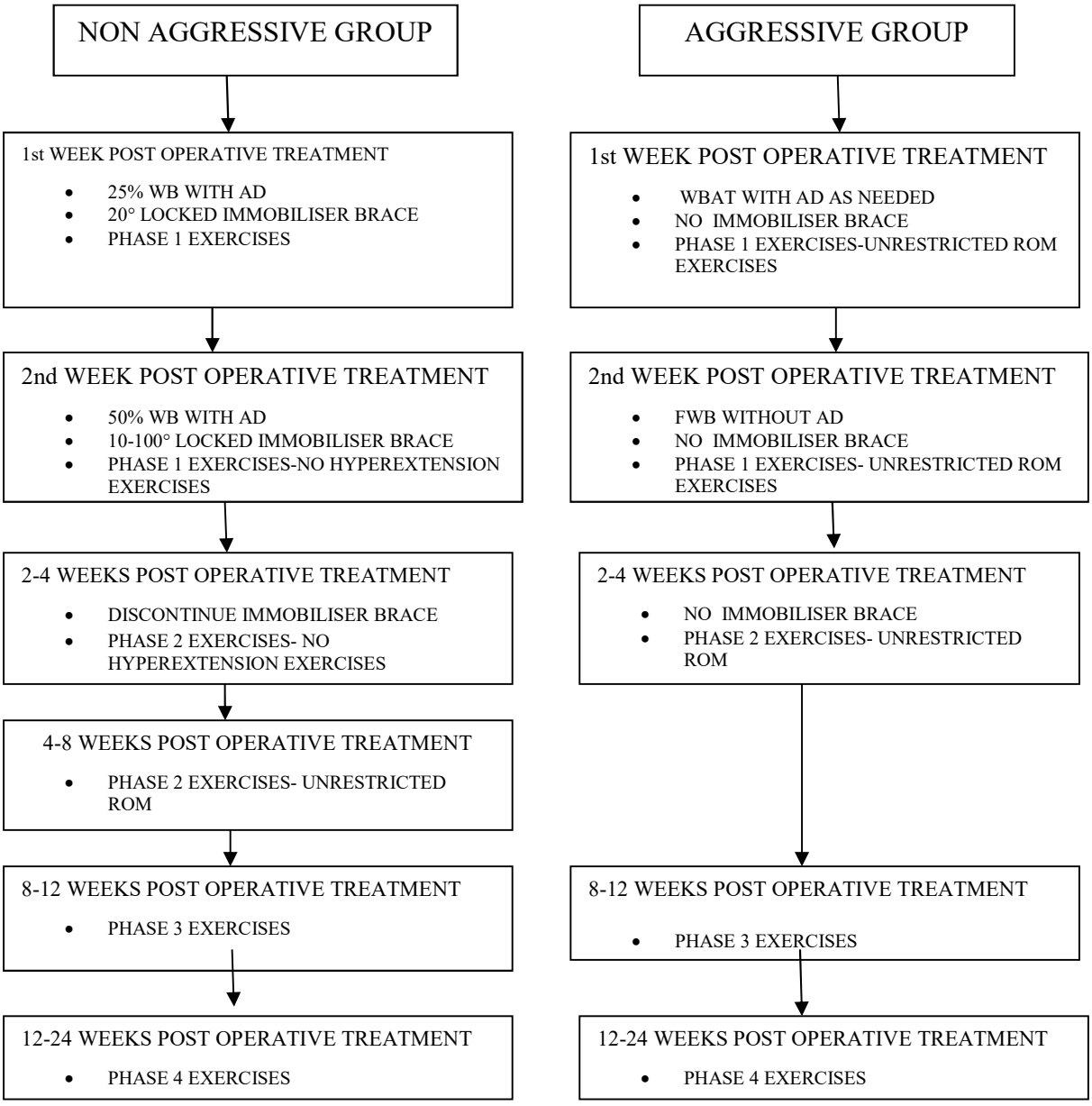

Figure 1:- Treatment protocol for each group. Abbreviations: WB, weight-bearing; AD, assistive device; CPMM, continued passive-motion machine; ROM, range-of-motion; WBAT, weight-bearing as tolerated; FWB, full weight-bearing.

Exceptions to the protocol for the nonaggressive group were as follows: They were confined to a postoperative brace for 4 weeks and not allowed to perform any

hyperextension exercises for the first 6 weeks, and they were instructed to ambulate with a modified weight-bearing status for the first 2 weeks.

Standard post-operative physiotherapy protocol for both groups was as follows:-

•Phase I (0–4 wk) of the rehabilitation protocol included passive, active-assist, and active ROM exercises; stationary bicycling; muscle-activation exercises; and inflammation reduction.

•Phase II (4–8 wk) of the protocol emphasized progressive ROM exercises, muscle strengthening, neuromuscular-control training, and functional activities.

•Phase III (8–12 wk) of the protocol consisted of restoring full symmetrical passive ROM, increased muscle strengthening, higher level neuromuscular-control tasks, and running.

•Phase IV (12–24 wk) of the protocol involved progressive muscle strengthening, sport-specific neuromuscular-control training, plyometrics, sprinting, and cutting drills.

Patients were scheduled for the same number of physical therapy visits and established time periods for exercise progression.

Outcome Measures

The primary outcomes was subjective IKDC scores at 12 weeks, 24 weeks and 1 year. The secondary outcomes were the difference in ROM at the same duration.

The IKDC Subjective Knee Form was used to assess the patient's opinion about his or her knee function and possible associated problems.19 The IKDC is based on a 0-to-100 cardinal scale and a knee-specific subjective measure of symptoms, function, and sport activity.19 The IKDC has been shown to be a reliable and valid instrument in measuring patient-oriented clinical outcomes in daily and sport function.15,19 A dual-arm goniometer was used to measure knee flexion and -extension ROM in both knees, which has shown high reliability.20 The mobility of the knee was measured as described by Shelbourne et al.21 Knee extension was measured with the patient's heel positioned on a bolster to allow the examiner to measure the amount of extension, or hyperextension if present, with the patient in a seated position. Knee flexion was measured by instructing the patient to bend the affected knee as far as possible toward the buttocks in a seated position. The outcome score used for analysis was expressed as the difference in ROM between the surgical and nonsurgical knees for both flexion and extension.

Statistical Analysis

Group 1 was defined as patients undergoing the standard rehabilitation protocol or the non-aggressive group, while group 2 was defined as patients undergoing aggressive rehabilitation. The data was initially captured in the customized proforma designed for the study. Then the data from this customized proforma was entered into the Microsoft Excel for analysis and online software were used for calculating the statistical significant. Unpaired 't' test was used to compare the difference of mean between the two groups, Pearson chi-square of 2x2 was used to compare the two groups. A p value of < 0.05 was taken as statistically significant. The final data was presented in the form of tables and graphs

Results

Seventy patients were enrolled in the study from June 2015 to August 2017. 56 men and 19 women initially met the inclusion criteria for the study. Four men and one woman were later excluded after operative findings indicated the need for meniscal repair. Thus, 70 subjects underwent randomization and began the postoperative rehabilitation protocol. 35 patients each were randomized to the aggressive and

nonaggressive group respectively. Baseline characteristics were not different between groups. No subject was lost to follow-up.

Table No. 1
Distribution of patients according to age in the partial weight bearing and full weight bearing groups

(N=70)

Age Group	Partial Weight Bearing (n=35)		Full Weight Bearing (n=35)	
	No.	%	No.	%
16-20 years	4	11.4	6	17.1
21-30 years	11	31.4	18	51.4
31-40 years	20	57.1	11	31.4
Total	35	100.0	35	100.0
Mean ± SD (age, years)	30.00 ± 6.01		27.77 ± 5.98	
't' value, df	1.555, df=68			
P value	0.125, NS			

Unpaired 't' test applied. P value < 0.05was taken as statistically significant

The above table shows the distribution of patients according to age in both the partial weight bearing and full weight bearing groups.

Table No. 2
Distribution of patients according to gender in the partial weight bearing and full weight bearing groups

(N=70)

Gender	Partial Weight Bearing (n=35)		Full Weight Bearing (n=35)	
	No.	%	No.	%
Female	9	25.7	7	20.0
Male	26	74.3	28	80.0
Total	35	100.0	35	100.0

$\chi 2$ test applied (2x2). $\chi 2$ value = 0.324, df=1, P value = 0.569, Not significant

Table No. 3

Comparison of mean ROM at different time intervals between the partial weight bearing and full weight bearing groups

Parameter	Time Interval	Group	Mean ± SD	't' value	P value
ROM	4 weeks	Partial weight bearing	78.23 ± 10.42	-6.877, df=68	0.000*
		Full weight bearing	93.57 ± 8.09		
	3 months	Partial weight bearing	97.89 ± 11.14	-9.629, df=68	0.000*
		Full weight bearing	121.00 ± 8.81		
	6 months	Partial weight bearing	118.86 ± 10.00	-4.186, df=68	0.000*
		Full weight bearing	127.06 ± 5.85		
	1 year	Partial weight bearing	130.63 ± 6.15	-9.573, df=68	0.000*
		Full weight bearing	141.43 ± 2.59		

Unpaired 't' test applied. P value < 0.05was taken as statistically significant

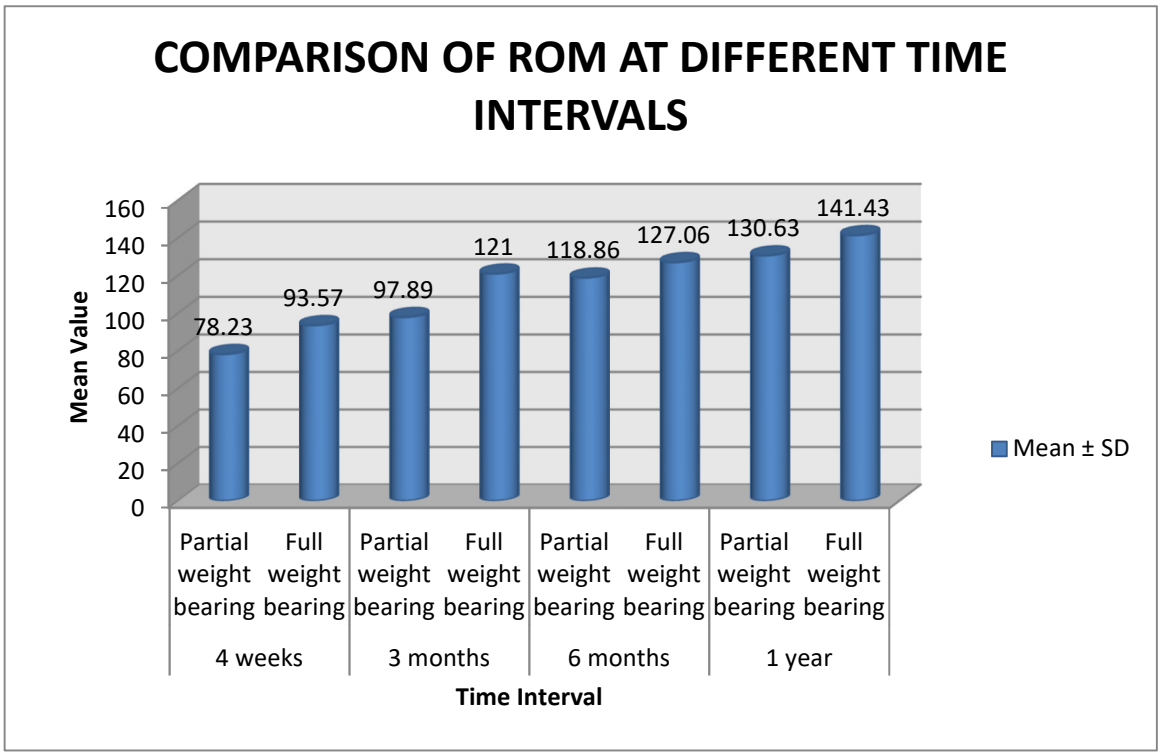

Fig.. : Bar diagram showing comparison of ROM at different time intervals between the partial weight bearing and full weight bearing groups

Table No. 4
Comparison of mean FFD at different time intervals between the partial weight bearing and full weight bearing groups

Parameter	Time Interval	Group	Mean ± SD	't' value	P value
FFD	4 weeks	Partial weight bearing	3.43 ± 3.16	6.704, df=68	0.000*
		Full weight bearing	1.26 ± 2.67		
	3 months	Partial weight bearing	1.11 ± 1.99	0.550, df=68	0.584, NS
		Full weight bearing	0.86 ± 1.91		
	6 months	Partial weight bearing	0.94 ± 1.85	2.112, df=68	0.038*
		Full weight bearing	0.23 ± 0.77		
	1 year	Partial weight bearing	0.37 ± 0.94	2.333, df=68	0.023*
		Full weight bearing	0.00 ± 0.00		

Unpaired 't' test applied. P value < 0.05was taken as statistically significant

The above table shows the comparison of mean FFD at different time intervals between the two groups.

Table No. 5
Comparison of mean 'Difference from Opposite Knee' at different time intervals between the partial weight bearing and full weight bearing groups

Parameter	Time Interval	Group	Mean ± SD	't' value	P value
Difference from opposite knee	4 weeks	Partial weight bearing	-58.91 ± 9.66	-5.861, df=68	0.000*
		Full weight bearing	-46.43 ± 8.09		
	3 months	Partial weight bearing	-39.26 ± 10.24	-8.871, df=68	0.000*
		Full weight bearing	-19.00 ± 8.81		
	6 months	Partial weight bearing	-18.29 ± 9.07	-2.929, df=68	0.005*
		Full weight bearing	-12.94 ± 5.85		
	1 year	Partial weight bearing	-6.51 ± 6.29	-6.908, df=68	0.000*
		Full weight bearing	1.43 ± 2.59		

Unpaired 't' test applied. P value < 0.05was taken as statistically significant

The above table shows the comparison of mean 'difference from opposite knee' at different time intervals between the two groups.

Table No. 6
Comparison of mean IKDC Score at different time intervals between the partial weight bearing and full weight bearing groups

Parameter	Time Interval	Group	Mean ± SD	't' value	P value
IKDC Score	4 weeks	Partial weight bearing	30.02 ± 2.80	-8.318, df=68	0.000*
		Full weight bearing	34.68 ± 1.77		
	3 months	Partial weight bearing	51.98 ± 1.54	-66.018, df=68	0.000*
		Full weight bearing	72.27 ± 0.97		
	6 months	Partial weight bearing	80.50 ± 0.00	0.960, df=68	0.340, NS
		Full weight bearing	79.84 ± 4.07		
	1 year	Partial weight bearing	88.43 ± 4.06	-8.917, df=68	0.000*
		Full weight bearing	96.11 ± 3.09		

Unpaired 't' test applied. P value < 0.05was taken as statistically significant

Overall, we found better results in group 2 (full weight bearing) as compared to group 2 (partial weight bearing) in terms of IKDC scoring, range of motion (ROM), ROM difference from opposite knee and fixed flexion deformity. The results were statistically significant.

Adverse events relative to motion limitations were present in both groups. Three patients (aggressive group n = 2 and nonaggressive group n = 1) required additional visits due to motion limitations, which were deemed necessary by the treating orthopedic surgeon. No other complication was noted.

Discussion

This randomized clinical trial evaluated the effects of early aggressive rehabilitation on patients recovering from ACL-R using STG autograft, while observing the relationship between clinical measures that are paramount in determining a successful outcome. Early aggressive rehabilitation compared with nonaggressive rehabilitation was found to be significantly better in this cohort of patients in relation to primary outcomes of subjective IKDC scores.

Subjects in the aggressive group did demonstrate a significant difference in ROM compared with the nonaggressive group. Our findings support the current body of literature as it pertains to BPTB grafts. Previous studies have compared the effects of early aggressive rehabilitation protocols on outcomes after ACL-R using BPTB grafts, indicating it to be appropriate to proceed through postoperative management without immobilizing the knee, restricting early hyperextension motion, or delaying weight bearing [9,14,15,21].

The primary goal after ACL-R is to restore knee stability and function in preparation for patients to return to their previous level of activity. However, even with advancements

in surgical techniques and rehabilitation protocols, there is strong evidence that deficits in lower extremity strength, neuromuscular control, and proprioception are continually present as patients are released back to unrestricted sport function[22,23]. Paterno et al reported that female athletes who had been cleared for full unrestricted sport activity still present with significant landing and jumping asymmetry during a vertical drop-jump task that has been used to predict ACL injury risk [24]. This evidence demonstrates that higher-level rehabilitation methods need to be emphasized in later stages of recovery after ACL-R in hopes of reducing the residual limb asymmetries and potentially decreasing the risk of future re injury. Furthermore, future research is needed to establish an objective criterion based on functional testing and outcomes before returning patients back to unrestricted sport after rehabilitation.

Early aggressive rehabilitation has been established for years, but there are discrepancies in the literature relative to overemphasis on BPTB grafts and lack of postoperative management on STG grafts. Our findings are clinically relevant since STG autografts have gained popularity in comparison with other graft choices, and limited research has been conducted evaluating the effects of early aggressive rehabilitation on functional outcomes. This evidence is important for guiding clinicians in making appropriate decisions on postoperative rehabilitation and restrictions after surgery, because there still appears to be conflicting evidence [14]. The current study appears to indicate that an early aggressive postoperative protocol is superior to a nonaggressive rehabilitation protocol after an isolated ACL-R using STG autograft.

The current study had certain limitations. First, outcomes like A-P knee laxity were not gathered. Second, no independent blinded data collector was used in this study, leading to potential performance bias. Third, our small sample size was small and composed of active subjects, and we were unable to stratify groups by activity level.

Conclusion

We found early aggressive rehabilitation to be superior to nonaggressive rehabilitation after isolated ACL-R using STG autograft for the primary outcomes of knee ROM, FFD and subjective IKDC score. The study emphasizes that early aggressive rehabilitation in such cases is better at restoring the normal function of knee when evaluated objectively as well as subjectively.

References

1. Baquie P and Brukner P (1997): Injuries presenting to an Australian sports medicine centre: A 12–month study. Clinical Journal of Sports Medicine 7: 28–31.
2. Miyasaka KC, Daniel DM, Stone ML and Hirshman P (1991): The incidence of knee ligament injuries in the general population. The American Journal of Knee Surgery 4: 3–8.
3. Seward H, Orchard J, Hazard H and Collinson D (1993): Football injuries in Australia at the elite level. Medical Journal of Australia 159: 298–301.
4. Barrack RL, Bruckner JD, Kneisl J, Inman WS and Alexander AH (1990): The outcome of nonoperatively treated complete tears of the anterior cruciate ligament in active young adults. Clinical Orthopaedics and Related Research 259: 192–199.
5. Fetto JF and Marshall JL (1980): The natural history and diagnosis of anterior cruciate ligament insufficiency. Clinical Orthopaedics and Related Research 147: 29–38.
6. Frank CB and Jackson DW (1997): The science of reconstruction of the anterior cruciate ligament. Journal of Bone and Joint Surgery 79A: 1556–1576.
7. Reinhardt KR, Hetsroni I, Marx RG. Graft selection for anterior cruciate ligament reconstruction: a level I systematic review comparing failure rates and functional outcomes. Orthop Clin North Am. 2010;41(2):249–262.

8. Heijne A, Werner S. A 2-year follow-up of rehabilitation after ACL reconstruction using patellar tendon or hamstring tendon grafts: a prospective randomised outcome study. Knee Surg Sports Traumatol Arthrosc. 2010;18(6):805–813.
9. Isberg J, Faxen E, Brandsson S, Eriksson BI, Karrholm J, Karlsson J. Early active extension after anterior cruciate ligament reconstruction does not result in increased laxity of the knee. Knee Surg Sports Traumatol Arthrosc. 2006;14(11):1108–1115.
10. Muneta T, Sekiya I, Ogiuchi T, Yagishita K, Yamamoto H, Shinomiya K. Effects of aggressive early rehabilitation on the outcome of anterior cruciate ligament reconstruction with multi-strand semitendinosus tendon. Int Orthop. 1998;22(6):352–356.
11. Rodeo SA, Arnoczky SP, Torzilli PA, Hidaka C, Warren RF. Tendon-healing in a bone tunnel: a biomechanical and histological study in the dog. J Bone Joint Surg Am. 1993;75(12):1795–1803.
12. Ekdahl M, Wang JH, Ronga M, Fu FH. Graft healing in anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc. 2008;16(10):935–947.
13. Shelbourne KD, Gray T. Minimum 10-year results after anterior cruciate ligament reconstruction: how the loss of normal knee motion compounds other factors related to the development of osteoarthritis after surgery. Am J Sports Med. 2009;37(3):471–480.
14. Wright RW, Preston E, Fleming BC, et al. A systematic review of anterior cruciate ligament reconstruction rehabilitation: part I: continuous passive motion, early weight bearing, postoperative bracing, and home-based rehabilitation. J Knee Surg. 2008;21(3):217–224.
15. Shelbourne KD, Klootwyk TE, Wilckens JH, De Carlo MS. Ligament stability two to six years after anterior cruciate ligament reconstruction with autogenous patellar tendon graft and participation in accelerated rehabilitation program. Am J Sports Med. 1995;23(5):575–579.
16. Holm I, Oiestad BE, Risberg MA, Aune AK. No difference in knee function or prevalence of osteoarthritis after reconstruction of the anterior cruciate ligament with 4-strand hamstring autograft versus patellar tendon-bone autograft: a randomized study with 10-year followup. Am J Sports Med. 2010;38(3):448–454.
17. Poolman RW, Farrokhyar F, Bhandari M. Hamstring tendon autograft better than bone patellar-tendon bone autograft in ACL reconstruction: a cumulative meta-analysis and clinically relevant sensitivity analysis applied to a previously published analysis. Acta Orthop. 2007;78(3):350–354.
18. Biggs A, Jenkins WL, Urch SE, Shelbourne KD. Rehabilitation for patients following ACL reconstruction: a knee symmetry model. N Am J Sports Phys Ther. 2009;4(1):2–12.
19. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the International Knee Documentation Committee subjective knee form. Am J Sports Med. 2001;29(5):600–613.
20. Brosseau L, Balmer S, Tousignant M, et al. Intra- and intertester reliability and criterion validity of the parallelogram and universal goniometers for measuring maximum active knee flexion and extension of patients with knee restrictions. Arch Phys Med Rehabil. 2001;82(3):396–402.
21. Shelbourne KD, Urch SE, Gray T, Freeman H. Loss of normal knee motion after anterior cruciate ligament reconstruction is associated with radiographic arthritic changes after surgery. Am J Sports Med. 2012;40(1):108–113.
22. Barber-Westin SD, Noyes FR. Factors used to determine return to unrestricted sports activities after anterior cruciate ligament reconstruction. Arthroscopy. 2011;27(12):1697–1705.
23. Myer GD, Paterno MV, Ford KR, Quatman CE, Hewett TE. Rehabilitation after anterior cruciate ligament reconstruction:criteria-based progression through the return-to-sport phase. J Orthop Sports Phys Ther. 2006;36(6):385–402.
24. Paterno MV, Ford KR, Myer GD, Heyl R, Hewett TE. Limb asymmetries in landing and jumping 2 years following anterior cruciate ligament reconstruction. Clin J Sport Med. 2007;17(4):258–262.

Original Article

Outcome of laminotomy and discectomy in lumbar intervertebral disc prolapse

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Abstract

Background: Lumbar disc prolapse is one of the most common causes of low back and radicular pain. Discectomy is by far the most commonly done surgical procedure for treatment of prolapsed lumbar intervertebral disc (PIVD). Many techniques have been advocated for discectomy and all the techniques have their advantages and limitations.

Methods: Forty-five patients with clinical symptoms and signs of prolapsed lumbar intervertebral disc having radiological correlation by MRI were subjected to disc excision by laminotomy method.

Results: The assessment was done by Japanese Orthopaedics Association score during follow up. Twenty-eight patients (62%) had excellent outcome, sixteen patients (36%) had good outcome and only one patient had poor outcome. There was a significant change in JOA score pre-operative and post-operative period. Statistically value of Chi square test is 18.89, df = 6, P value = 0.004. There were only four complications reported (8.8%).

Conclusion: The laminotomy and discectomy is an effective surgical option for treatment of lumbar disc prolapse having good to excellent functional outcome with low complication rate.

Keywords: Lumbar prolapse intervertebral disc; sciatica; laminotomy; discectomy

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Introduction

Vertical loading of the spine results in a variety of low back problems affecting majority of the human population. The low back pain [LBP] is experienced by 80-90% of the population worldwide [1]. LBP is second only to headache as a frequent source of pain in the body. Back pain is now appearing as a modern international epidemic. Up to 80 % of people are affected by this symptom at some time in their lives. Impairments of the back and spine are ranked as the most frequent cause of limitation of activity in people younger than 45 years by the National center for health statistics [2].

Prolapsed intervertebral disc (PIVD) is a major cause for low back pain and A Vast array of techniques exists for surgical treatment of herniated disc [3]. Standard open discectomy is the most common surgical approach, who failed to respond to conservative treatment like NSAID's, epidural steroid injection and physical therapy [4].

In 1934, Mixter and Barr published their study and concluded that laminectomy with decompression and extraction of herniated lumbar disc could improve suffering caused by sciatic pain [5]. However, the outcome studies of lumbar disc surgery document a success rate of 51 to 89%, in spite of advances in investigations, operative

technique (Microscopic and Endoscopic discectomy) and postoperative care [1,2].

Surgery for Lumbar PIVD has changed time to time and a great number of surgeons have contributed to develop newer techniques to operate upon prolapsed disc.

In our study, instead of removing whole lamina, spinous process and interspinous ligament to reach prolapsed disc, we have done laminotomy by cutting inferior aspect of superior lamina and excision of ligamentum flavum.

Technique of sparing supraspinous and interspinous ligaments does help in earlier rehabilitations of the patients, fastens the recovery and thereby reducing problems related to it. Other advantages of laminotomy are less soft tissue dissection which leads to less blood loss, reduced duration of surgery, and consequent reduction in surgical site infection. Apart from this, laminotomy does not need sophisticated instruments and setup like how it is required in micro-endoscopic discectemy and can be carried out with minimum financial loss to patient, more so over there is a steep learning curve associated with using the endoscopic operation system efficiently and safety.

Materials and Methods

Forty five patients were assessed clinically. A detailed history from patient was obtained and subjected to a thorough clinical examination. The findings were noted in the proforma. Radiological investigations (plain x-ray and MRI) were carried out to confirm the diagnosis and know the level of the lesion.

All patients underwent conventional open laminotomy and discectomy in prone position under general anaesthesia. The level and type of disc herniation was again assessed intra-operatively. Postoperatively the patients were followed up in the immediate post-operative day, 2nd week, 1st month, 3rd month and 6 months after the surgery.

The Japanese Orthopaedic Association low backache score was used pre and postoperatively to assess the outcome analysis of functional status.

The outcome is designated as excellent- 75 to 100% improvement, good- 51 to 74% improvement and poor- below 50% improvement.

The improvement in pain and neurological condition was recorded. Perioperative and postoperative complications, if any were noted.

Results

The mean follow up was 6.1months ranging from 1 to 13 months. Low back pain and radicular pain was the most common symptom with which patients presented. Other complaints were tingling and numbness (paresthesia), weakness over lower limb and difficulty in walking and posture. Four patients presented to us with cauda equina. On examination a positive straight leg raising test (SLRT) was the most common finding followed by restricted spinal movements and neurological deficits. Left side was most commonly involved. 23 patients had unilateral left side complaint and 4 patients had complaint on both sides, whereas 18 patients had complaint in right side.

Average duration of surgery in our study was 107 minutes, ranging between 45-180 minutes. Average hospital stay in our study was 8.5 days ranging between 5-12 days. Average blood loss was 110 ml ranging between 80-250 ml.

Thirteen out of 45 patients (29%) had pre operative JOA score of 1-5 and 32 patients (71.1%) had between 6-9. No patient presented with JOA score between 10-15. There was dramatic change in JOA score post operatively, where 36 patients (80%) had score between 13-15, seven patients

(16%) had score between 10-12 and only 2 patients (4.4%) had it between 6-9.

Observations of pre operative score were compared with results of surgical outcome which showed Chi square value of 18.89 and the P value was 0.004. This signifies that there was a statistically significant change in patient's symptom post operatively. Statistically value of Chi square test is, X2(Chi square test) = 18.89, df = 6, P value = 0.004 i.e. P < 0.05 which shows that the result is statistically significant. Twenty eight patients (62%) had excellent outcome and improvement rate >75%, 16 patients (36%) had good result and improvement rate between 50-75% and only 1 patient (2%) had poor result. four out of 41 with motor weakness and one patient with cauda equina syndrome did not improve post operatively.

Complication rate in our study of 45 patients was only 8.8 % out of which 2 patients (4.4%) had surgical site infection, 2 patients (4.4%) had dural tear. Fourty patients were without any complications. Out of 45 patients who had low back pain and radicular pain had no complaint post operatively, where as two patients out of 42 with paresthesia.

Events which precipitated the onset of pain were analyzed. History of doing heavy manual work was present in 73% (33 cases) which includes labour, farmer driver and coolie. Insidious onset was present in 27% (12 cases) which includes housewives and students.

Discussion

What low back pain lacks in lethality it certainly makes up for in the wholesome misery it causes in modern industrial societies. Low back disorders have become the most common musculoskeletal disorder, with a major impact on the costs of health care and are a major source of disability6. The origins of disc related sciatica with its clear morphologic and clinical neurologic findings were not recognized until the 20th century. Literature says there is a considerable number of failed back surgeries also which may require revision surgery. The recurrence rate for lumbar disc excision varies from 6% to 11% in various studies 8, 9, 11, 12. This implies that there are many factors which influence the outcome of lumbar disc surgery. Therefore emphasis should be laid on proper patient selection.

In our study male were aged between 23-60 yrs with a mean of 39.28 and females were aged between 25-59 yrs with mean of 41.31yrs. Similar age group was seen in study conducted by K. N. Acharya18 et al, J. Weinstein17 et al and Sangwan13 et al. In our study we found that patients with age group less than 40 yrs had better outcome than those with age group more than 40 yrs.

In our study 33 patients (73.44%) were heavy manual worker and 12 patients (26.66%) were medium strenuous worker including house wives and students which were of younger age group. Irrespective of the work group good to excellent result was seen, one patient with poor result was a farmer. Globally it is seen that patient indulged in strenuous work are vulnerable to disc prolapse. J. Weinstein17 et al in his study on 71 patient found that 85% (60) patients were labourer as profession and 15% (11) patients were non-labourer. S.S Sangwan13 et al also observed that only 3 out of 28 patients were sedentary worker and remaining 25 patients were labourer. Another study by S. K. Mishra16 et al on 67 patients found that 40 (60%) were involved in heavy work.

In our study single most commonly involved level was L4-5 level. Next most commonly involved level was L5-S1 level. J. Shi12 et al in his study on 60 patients reported less satisfactory outcome in L4-5 level discectomy, though no other study has

shown bad result with same level. Cauda equine syndrome is seen more in L4-5 level due to compression over traversing roots. J. N. Weinstein17 et al in his study reported L5-S1 as most commonly involved level. S. S. Sangwan13 et al reported most common level involvement as L5-S1 level followed by L4-5 level. Whereas K.N.Acharya18 et al, Barbara15 M. et al and Gupta24 et al in their study found L4-5 most commonly involved level followed by L5-S1.

In our study we found protruded disc was more common. Twenty six patients (57%) presented to us with protruded disc, extruded disc was found in seventeen patients (38%) and only two patients (4.4%) presented with sequestered disc. S. S. Sangwan13 et al in his study found that protrusion was most common type of herniation followed by extrusion. None of the patients in his study had sequestration. Bhavuk Garg 23et al mentioned that contained disc was common finding in his study. He also mentioned that contained disc or protruded disc has better outcome compared to extruded or sequestered disc prolapse.

Patients who presented to us within 6 months of commencement of their complaint had better post operative outcome than those who presented to us after 6 months. Rotheorl19 et al distinguished operatively treated patients according to time of presentation to surgery. Patients with symptom duration more than 2 months had a statistically significant worse outcome than patients operated within 2 months19. Likewise Hurme and Alaranta found the best results in patients operated within 2 months of the onset of disabling sciatica20. Nygaard et al reported worse result in patients with leg pain for 8 months or more21. Sorenson et al found that symptom duration greater than 16 months was predictive of poor results, but this was highly influenced by patient personality and social factors22.

In our study we found excellent result in 28 patients (62.2%), good result in 16 patients (35.6%) and poor result in only one patient. Low back pain and radicular pain was cured in all the patients but two patients had persistent sensory weakness and four patients had persistent motor weakness. Overall result in our study was excellent. Bhavuk Garg et al23 in comparative study between microendoscopic discectomy and laminotomy with discectomy found near similar surgical outcome in both the groups(95% in MED group and 90% in laminotomy group) at the end of six months and one year, but he emphasized that there were more complications with MED group. Chances of recurrent herniation at same level were found to be with MED group. Sangwan13 et al had excellent result in 17 patients, good result in 6 patients and fair result in 2 patients with fenestration and laminotomy procedure. James N. Weinstein17 in his study on 719 patients, with open discectomy had 90% good to excellent result. O. N. Nagi25 et al in their study on sixty patients found 93% good to excellent result with fenestration and laminotomy technique. Ebeling 26et al., Caspar14 et al and R. Silvers3 published their study with micro endoscopic technique and found good outcome in 73%, 74% and 95% respectively, whereas newer studies with micro endoscopic technique has yielded more than 90% good result. S. K. Mishra16 et al in a study comparing results of wide Laminectomy and interlaminar fenestration. The study found 90% satisfactory outcome in fenestration group and 80% in Laminectomy group, there was less incidence of post operative back pain with fenestration group.

Conclusion

Laminotomy and discectomy is an effective surgery for treatment of lumbar disc prolapse. Consistently good to excellent results (96%) in our study could be

attributed to proper selection of cases and a meticulous surgical protocol. The results of lumbar discectomy are good when there is agreement between clinical presentation and imaging studies as it was seen in our study.

In our study we achieved results comparable to that achieved with microdiscectomy. Microsurgical techniques may have some advantages in terms of a less invasive approach; shorter hospital stay and less blood loss, but one must understand the demands, requirements, and limitations of this technique. It requires a steep learning curve and it is a technically demanding procedure in terms of surgical skills of the surgeon and equipment required and thus is available only in multispeciality hospitals.

Unlike laminectomy this procedure is less destructive, spinal stability is maintained, duration of surgery is less hence there is less blood loss and chances of infection is less, laminotomy and discectomy is more cost effective than microdiscectomy.

References

1. Hult L: The Munkfors investigations, Acta Orthop Scand Suppl 16:1, 1954.
2. Waddell G, Main CJ, Morris EW, et al:, Chronic low back pain, psychological distress, and illness behavior, Spine 9:209, 1984.
3. Silvers H.R.: “Microsurgical versus standard lumbar discectomy”. Neurosurgery, 1988, 22(5): 837-841.
4. Sharma S C, Singh R, Sharma AK, Mittal R: Incidence of low back pain in work age adults in rural North India. Indian J Med Sci, 2003 Apr;57(4):145-7
5. Mixter W.J., J.S.Barr, 1934: “Rupture of the intervertebral disc with involvement of the spinal canal”. N Engl J Med, 211: 210-215.
6. Nachemson AI. The lumber spine, an orthopaedic challenge. Spine 1976;11:59–71.
7. Duthie, Robert B. : “Affections of the spine”. Chapter-13, Mercer’s orthopaedic surgery, 9th Edn., Edt. Duthie, Robert B. and George Bentley, London; Arnold, 1996:915-1014pp.
8. Frymoyer, John W., 1988: “Medical progress – Back Pain and sciatica”. N Engl J Med, 318(5):291-300.
9. Spengler, Dan M.:“Lumbar disc herniation”. Chapter-19, Operative orthopaedics, Vol.IV, 2nd Edn., Edt. Chapman, Michael W., New-York; Lippincott Raven Publishers, 2003: 2735-2744pp.
10. Katz JN: Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. J Bone Joint Surg Am.2006 Apr:88 supl 2:21-4.
11. Kambin P, H.Gellmann: “Percutaneous lateral discectomy to the lumbar spin”. Clin Orthop: 1983 :14: 127-132.
12. J Shi, Y Wang, F Zhou, H. Zhang, H. Yang: Long term clinical outcomes in patients undergoing lumbar discectomy by fenestration. J Int Med Res:2012;40(6):2355-61.
13. SS Sangwan, ZS Kundu, Raj Singh, P Kamboj, RC Siwach, P Aggarwal “Lumbar disc excision through fenestration”. IJO 2006, 40(2): 86-89.
14. Caspar W., Campbell B, Barbier DD, Kretschmmer R, Gotfried Y: “The caspar microsurgical discectomy and comparison with a conventional standard lumbar disc procedure”. Neurosurgery,1991, 28(1): 78-86.
15. Barbara M., Knop Jergas, James E Zucherman, Ken Y hsu, Bradford Delong : “Anatomic position of a herniated Nucleus Pulposus predicts the outcome of Lumbar Discectomy”. Journal of spinal disorder,1996 9(3):246-250.
16. Mishra SK, Mohapatra NC, Pradhan NK, Mohapatra MK: “Lumbar disc excision: comparative study of Laminectomy and interlaminar fenestration”. IJO,1998, 32(3):153-155.
17. James N.Weinstein, Jon D. Lurie, Tor D. Tosteson, Jonathan S. Skinner, Brett Hanscom,et al.: “Surgical vs Nonoperative treatment for lumbar disc herniation” JAMA 2006, 296(20): 2451-2459.
18. KN Acharya, TS Senthil Nathan, J Renjit Kumar, K Venugopal Menon :“Primary and revision lumbar discectomy: A three year review from one centre”. IJO, April 2008, 42(2): 178-181.
19. Rothoerl RD, Woertgen C, Brawanski A: when should conservative treatment for lumbar disc herniation be ceased and surgery considered? Neurosurg Rev 25:162-165,2002.
20. Hurme M, H.Alaranta,: “ Factors predicting the result of surgery for lumbar intervertebral disc herniation”. Spine (phila Pa 1976) 12(9): 933-938, 1987.

21. Nygard OP, Kloster R, Solberg T: Duration of leg pain as a predictor of outcome after surgery for lumbar disc herniation: A prospective cohort study with 1- year follow up. J Neurosurg 92:131-134,2000.
22. Sorenson LV, Mors O, Skovlund O: A prospective study of the importance of psychological and social factor for the outcome after surgery in patients with slipped lumbar disc operated upon for the first time. Acta Neurochir (Wien) 88:119-125, 1087.
23. Garg Bhavuk, Nagraja, Upendra Bidre,Jayaswal Arvind : Microendoscopic versus open discectomy for lumbar disc herniation: a prospective randomized study. Journal of Orthopaedic Surgery 19.1 (Apr 2011): 30-4.
24. Gupta S.K., Prakash V, Dutt MR, Vijay Kumar, Chari STR: "Surgery in lesions of lumbar intervertebral disc degeneration". Ind J Ortho, 23(1): 44-51.
25. Nagi O.N., A.Sethi and S.S.Gill,: " Early results of discectomy by fenestration technique in lumbar disc proplapse". Ind Orthop, 1985: 19(1): 15-19.
26. Ebeling K, W.Reichenberg and H.J.Reulen,: "Results of microsurgical lumbar discectomy: Review on 485 patients". Acta Neurochir, 1986, 81: 45-52.

Case Report

Salter-Harris type II fracture of the femoral bone in an 8-year old boy- A Case Report

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Abstract

Introduction: Distal femur epiphyseolysis, i.e. separation of physis at the distal femur in the immature skeleton of children consists of physis displacement or fracture or both is rarely seen and is often associated with complications. Physeal fractures or dislocation (also known as knee dislocation) should be treated as a medical emergency usually within 6 hours of trauma by adequate reduction, stabilization and vascular injury repair in order to prevent pre-mature physeal closure, deformity and growth arrest thereby leading to limb length discrepancy.

Case Report: Reported here is a rare case of Salter Harris type II fracture dislocation of the distal femur in an 8-year-old boy who presented to our hospital with swelling and flexion deformity of the left knee 15 days after trauma and was previously treated with slab application and immobilization at a rural health centre. Open reduction and internal fixation was performed with Kirschner wires. These were removed after 6 weeks. Post-operative evaluation after 4 months showed no deformity or limb length discrepancy. Radiograph was suggestive of adequate alignment and no bony abnormality.

Conclusion: Although rare, distal femur epiphyseal injuries of the childhood are of a great concern because of the degree of bone deformities, growth disturbances and significant disabilities caused by them. A detailed study of the these type of injuries helps in deciding the treatment methods and procedures to be opted, which eventually affects the prognosis and outcome in such cases.

Keywords: Salter Harris, distal femur fracture, knee dislocation, vascular injury, growth plate

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Introduction

The distal femur epiphysis, being the fastest growing epiphysis grows at an approximate rate of 1cm/year. It contributes in 70% growth of femur and in total accounts for 35% growth of the lower extremity [1-3]. Fractures of the distal end of the femur in childhood are classified by Salter Harris which is helpful in the radiological evaluation and predicting the outcome. As epiphysis is the most fragile part, it is prone to injury [4-5]. Due to higher physiological load, shortenings & deformities are poorly tolerated in the lower limb. As compared to the upper limb; prognosis of the lower limb fractures is poorer [6].

Case Report

An eight-year-old boy visited our institution's outpatient department with chief complaints of pain, swelling, deformity and inability to bear weight on the left lower limb for 15 days. The patient gave a history of fall from the farming machine. He had received primary treatment at a district hospital in the form of slab immobilization and analgesics.

On examination, fixed flexion deformity of the left knee and limb length discrepancy was noted. There was no neuro vascular deficit. On radiographic examination, displaced Salter Harris type 2 distal femur epiphiseal injury was seen (Figure-1) and operative correction was planned.

The patient was operated under spinal anesthesia by open reduction and internal fixation using kirschner wires and limb was immobilized using plaster slab (Figure-2). The Kirschner wires were removed after 4 weeks and physiotherapy was started. On a 4 month follow up visit, the patient was walking full weight bearing with no deformity or limb length discrepancy. The 4 month post operative radiograph showed proper bone alignment and absence of any deformity (Figure-3).

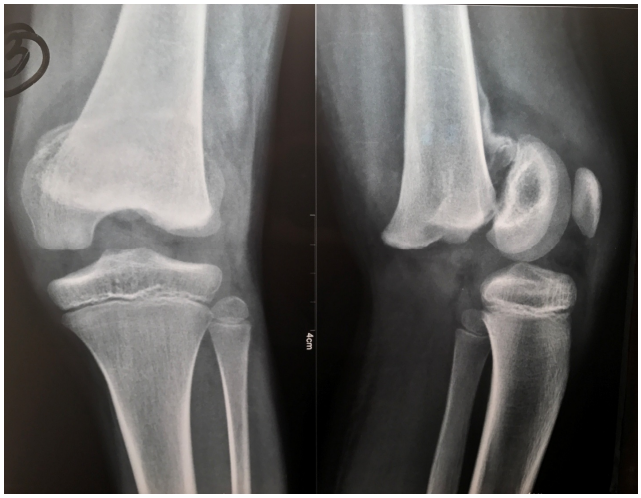

Figure1: AP and lateral radiographs

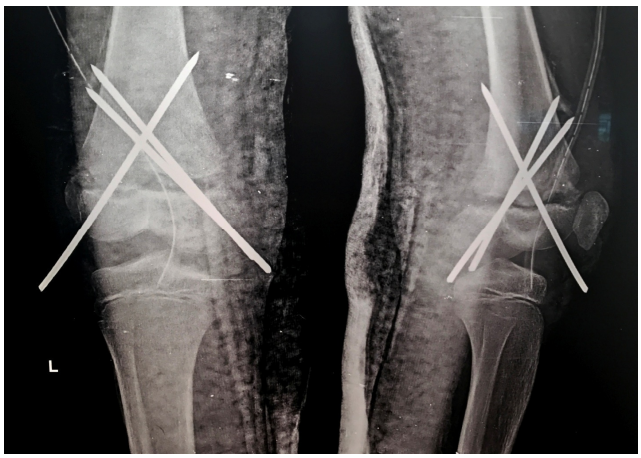

Figure2: Post-Op AP and lateral radiographs

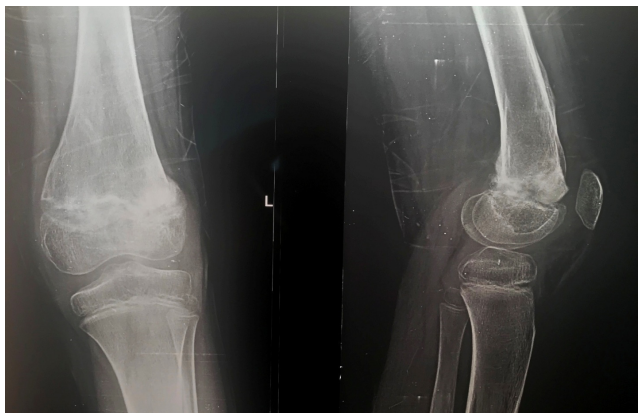

Figure 3: 4-month Post-Op radiographs

Discussion

The growth plate, contains germinal cells that create longitudinal bone growth, are cartilaginous in nature. Physes, being the weakest point of the immature skeleton, account for only 20% of all fractures in children. Distal femur epiphyseal injuries are rare and contribute about 1% to 6% of all growth plate injuries [7].

Out of all the epiphyseal injuries around the knee, most common are the distal femur injuries, a reason being the stress to the knee ligaments causing traction thereby resulting in physeal-epiphyseal injuries.

Sports injuries and road traffic accidents constitute the most common causes of distal epiphyseal injuries. The treatment of these injuries is of utmost importance as this zone of growth contributes to 40% of lower extremity length and 70% of the entire femur. Previously, Neer in his work reported a limb length discrepancy of 42% [8]. Cassebaum and Patterson reported the discrepancy of about 25% [9]. MRI, apart from X-ray, is an investigation of choice in such cases for evaluation of post injury disturbances and clinically significant angulation.

Many studies and experiments aim at eliminating the risk of formation of a bone bridge. In previous studies, autologous fat was used to fill the growth plate defect. [10] A modern experimental approach include

excision of the bone bridge and defect compensation with tissue alternatives such as mesenchymal stem cells [10] or autologous chondrocytes. [11]

Conclusion

Although rare, distal femur epiphyseal injuries of the childhood are of a great concern because of the degree of bone deformities, growth disturbances and significant disabilities caused by them. A detailed study of these type of injuries helps in deciding the treatment methods and procedures to be opted, which eventually affects the prognosis and outcome in such cases

References

1. Sponceller PD, Stanitski CL. Distal femoral epiphyseal frac¬tures. In: Beaty JH, Kasser JR, eds. Rockwood and Wilkins' Fractures in Children. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2001:982-1010.
2. Pritchett JW. Longitudinal growth and growth-plate activity in the lower extremity. J Pediatr Orthop. 1992;2(4):557.
3. Zionts LE. Fractures around the knee in children. J Am Acad Orthop Surg. 2002;10:345-355.
4. Brown JH, DeLuca SA: Growth plate injuries: Salter-Harris classification. Am Fam Physician, 1992; 46: 1180–84
5. Ilharreborde B, Raquillet C, Morel E et al: Long-term prognosis of Salter-Harris type 2 injuries of the distal femoral physis. J Pediatr Orthop B, 2006; 15: 433–38
6. Chadwick CJ, Bentley G: The classification and prognosis of epiphyseal injuries. Injury, 1987; 18: 157–68
7. Ogden JA. Skeletal injury in the child. 3rd ed. New York: Springer, 2000: 1198 pp.
8. Neer CS. Separation of the lower femoral epiphysis. Am J Surg 1960; 99: 756–761.
9. Cassebaum WH, Patterson AH. Fractures of distal femoral epiphysis. Clin Orthop 1965; 41: 79–91.
10. Plánka L, Nečas A, Gál P, et al. Prevention of bone bridge formation using transplantation of the autogenous mesenchymal stem cells to physeal defects: an experimental study in rabbits. Acta Vet Brno 2007; 76: 257–266.
11. Gál P, Nečas A, Adler J, Teyschl O, Fabián P, Bibrová Š. Transplantation of the autologous chondrocyte graft to physeal defects: an experimental study in pigs. Acta Vet Brno 2002; 71: 327–332.