International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(2): 819-823

www.orthopaper.com
Received: 19-02-2018
Accepted: 20-03-2018

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Comparative analysis of two different surgical treatments: Distal fermoral fractures

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DOI: https://doi.org/10.22271/ortho.2018.v4.i2l.119

Abstract

Introduction: The treatment of distal fermoral fractures has been a controversial topic and it's recently evolved towards indirect reduction and minimally invasive techniques.

Objective: To compare the results of the surgical treatment of distal fermoral fractures with a plate with screws for appendage compression functions with the minimally invasive stabilization.

Material and methods: Patients with distal fermoral fractures treated surgically between January 2016 to January 2018 were assessed retrospectively. The subsequent variables were registered from each patient record: age, sex, form of fracture and mechanism of injury, type of implant used, operative time and postoperative bleeding. The Neer scale was accustomed compare the anatomical, radiologic and useful results of each techniques.

Results: The total number of patients was 59; thirty three males and twenty six females; mean age was 58 years. A plate with screws was employed in 36 patients for appendage compression purposes, and a minimally invasive stabilization system in 23. The cases managed with a minimally invasive stabilization system had a shorter operative time and less intraoperative bleeding. The results of the analysis victimization the Neer scale were similar for each modalities.

Conclusions: The patients with fracture of the distal third of the femur managed with a minimally invasive stabilization system had higher outcomes, that weren't vital within the Neer scale, mainly due to less pain intensity, early mobilization and less functional repercussions.

Keywords: Fracture, femur, knee, surgery, technic, comparative study

Introduction

There are no correct estimates of the prevalence and incidence of thighbone fractures around total knee arthroplasties [1]. Throughout the historic evolution of orthopaedic surgery the treatment of distal thighbone fractures has not achieved clinical results with a high quality love the remainder of the limb fractures. The presence of skinny cortices, pathology, wide medullary canals, and fracture comminution build it tough to get and maintain a stable fixation [2, 3]. The goal of the treatment of thosefractures is that the anatomic reduction of the articulary surface, restoration of the limb length, alignment and rotation, also as allowing associate degree early limb mobilization to avoid articulary stiffness and also the loss of muscle mass [4].

The surgical procedure of long bone fractures has evolved emphasizing the minimization of the additional biologic damage caused by the surgical trauma. Indirect reduction techniques consisting of exerting traction through the soft tissues to achieve fracture reduction have been introduced and that they have step by step replaced the open reduction techniques. This indirect approach is known as internal biological fixation [5, 6].

Together with the previous, varied minimally invasive techniques are enforced recently. The implant called less invasive stabilization system (LISS) stands out among them and consists of a pre-contoured plate that will be percutaneously inserted when the closed reduction of the fracture [6, 7].

In the literature, osteopenia and gonarthrosis might complicate their management. Moreover, there's a high rate of open distal femur fractures [8, 9], the treatment of distal femur fractures has long been a arguable topic. Towards 1950-1960 the conservative approach was predominant [10], AO introduced the mounted angular plate for the treatment of distal femur fractures [11, 12].

Distal thighbone fractures treated with internal fixation employing a 95° angular plate and a strengthened appendage plate [13].

The objective of this study is to present the results of the surgical treatment of supracondylar femoral fractures (types A, B, C) in keeping with the AO/ASIF classification using two treatment modalities: a plate with appendage compression screws and the less invasive stabilization system.

Material and methods

This observational, retrospective, cross-sectional study reviewed the clinical files of all patients who underwent surgery due to a distal femur fracture from January 2016 to January 2018. Before beginning the study, the Hospital Review Board approved this retrospective study and granted a release of consent. (Gandhi Medical faculty could be a medical faculty in Gandhi Medical college, Secunderabad, Telangana, India.)

The inclusion criteria were as follows: first of all, complete clinical records; second, patients with distal leg bone fracture together with all degrees of severity; third, the fractures should are surgically treated either with open reduction and a plate with appendage compression screws or through indirect reduction and a less invasive stabilization system; fourth, patients followed-up as outpatients for a minimum of six months. Patients but eighteen years elderly were excluded furthermore as those with Associate in Nursing interval between the fracture and therefore the surgery longer than one week, patients with a fracture treated at the start with a special kind of implant, and people with a diagnosing of periprosthetic fracture.

Applying these choice criteria, a complete of fifty nine patients were known and set up the sample. the subsequent variables of every patient record were analyzed: Age, sex, mechanism of fracture, kind of fracture per the AO/ ASIF classification [14], surgery modality, operative time and volume of intraoperative harm. On the opposite hand, throughout the follow-up at operative weeks three, 6, nine and twelve the subsequent variables were recorded: Pain prevalence and severity, vary of motion of the ginglymus, radiologic proof of healing, and complications. On the other hand, the results obtained at postoperative month 6 were assessed using the modified neer scale [15].

The statistical analysis consisted of descriptive statistics (percentage, range, mean, standard deviation using Origin Pro 7.6 statistical software), using the standard methods. The comparison of variables between both treatment modalities was done using the chi-square test for the categorical variables and the Student t-test for the independent samples in the case of numerical variables. The comparison of ordinal variables of the neer scale was performed using the Kruskal-Wallis test.

Results

The review included a total of 59 patients, 57.6% of whom were males (33/59) and 44% females (26/59). Patient age ranged between 18 and 78 years, with a mean age of 58 years; the distribution in age groups is shown in chart 1.

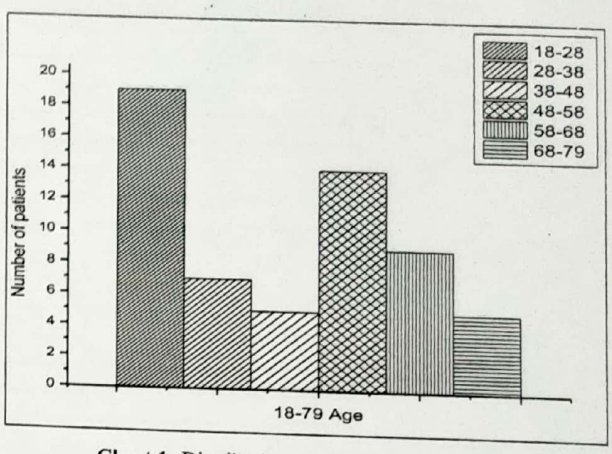

Chart 1: Distribution of patients by age group.

A high-energy mechanism was reported as the cause of fracture in 71% of cases (42/59), and a low energy mechanism was reported in 28.8% (17/59). None of the patients had bilateral fracture, so according to the AO/ASIF classification, among the 59 fractures the predominant type was 33A 1.1, reported in 31% of cases (18/59), followed by types 33A 1.2, with a frequency of 15% (9/59) and 33C 1.1, also with a frequency of 14% (8/59). The distribution of fractures according to their frequency based on the types included in this classification is summarized in table 1.

Table 1: Distribution of distal femur fractures according to the AO/ASIF classification.

Type	Number of fractures	Relative frequency (%)
33 A 1.1	18	31
33 A 1.2	9	15
33 C 1.1	8	14
33 A 2.1	5	8
33 A 2.2	4	7
33 A 3.3	3	5
33 A 1.3	3	5
33 B 1.2	2	3
33 C 1.3	2	3
33 A 2.3	2	3
33 A 3.1	1	2
33 B 1.1	1	2
33 C 1.2	1	2
Total	59	100

Of the total number of fractures, 76% (45/59) were closed and 24% (14/59) were open. According to the gustilo classification [16], 5 /16 open fractures were type I, 2/16 was type II and 9/16 were type IIIA. Fifty-four percent of the fractures (32/59) involved the right pelvic limb and 46% (27/59) the left one.

According to the surgical treatment modality for fracture fixation, in 36/59 patients (61%) an implant consisting of a plate with condylar compression screws was used (Group I), and in 23/52 patients (39%) the less invasive stabilization

system was used (Group II).

When comparing the overall characteristics of the patients in each group, no significant differences were found in age and sex. However, a significant predominance was found in the proportion of fractures caused by a high energy mechanism in Group I patients (Table 2).

Table 2: Patient characteristics and mechanism of injury.

	Group I	Group II	*P* - Value
N	36	23	
Age	51.2±16.52	50.5± 19.36	0.65*
Gender	Males 21/36	Males 16/23	
	Females 15/36	Females 7/23	0.92†
Mechanism of injury	High energy 29/36	High energy 15/23	
	Low energy 7/36	Low energy 8/23	0.06†

* Student t-test; † Chi-square

The distribution of fractures according to the AO/ASIF classification for each treatment modality is summarized in table 3.

Table 3: Distribution of fractures by group according to the AO/ASIF classification

Type	Group I	Group II
33 A 1.1	11/36	6/23
33 A 1.2	7/36	4/23
33 C 1.1	5/36	3/23
33 A 2.1	3/36	3/23
33 A 2.2	2/36	1/23
33 A 3.3	3/36	1/23
33 A 1.3	1/36	1/23
33 B 1.2	1/36	
33 C 1.3	2/36	1/23
33 A 2.3	1/36	1/23
33 A 3.1		
33 B 1.1		1/23
33 C 1.2		1/23

A longer duration of the surgical procedure was seen in Group I, with a mean of 2hrs 20minutes, compared with Group II, with a mean duration of 1hr 40 minutes, with a statistically significant difference. The intraoperative bleeding volume was greater in the cases in which the implant consisting of a plate with condylar compression screws was used (mean bleeding: 756 cc), compared with Group II, which had a mean bleeding volume of 320 cc, with a statistically significant difference between them.

In 52% of the cases (19/36) in Group I a graft was used. No graft was used in Group II because the fracture site was intact. When the degrees of flexion obtained at postoperative months 1, 2 and 3 were compared, no significant differences were seen between both treatment modalities (Table 4).

Table 4: Evaluation of postoperative flexion (Degrees)

	Group I	Group II	*p* Value
Flexion at one month	33.26 ± 4.65	29.89 ± 2.98	0.98†
Flexion at two months	96.49 ± 6.96	98.84 ± 16.68	0.83†
Flexion at three months	104.55 ± 12.25	113.21 ± 18.96	0.52†

† Chi-square

The degree of bone healing was assessed at postoperative months 1, 2 and 3 for each of the groups; it is summarized in table 5.

Table 5: Evaluation of bone healing in both groups

	Group I		Group II	
	Grade	N	Grade	N
Healing at one month	Null	6/36	Null	11/23
	Incipient	25/36	Incipient	11/23
Healing at two months	Null	7/36	I	5/23
	Incipient	15/36	I-II	7/23
	Completed	16/36	II	15/23
Healing at three months	Incipient	3/36	Incipient	3/23
	Completed	23/36	Completed	20/23
Healing at six months	Delayed	3/36	Delayed	2/23

Patients in whom a plate with condylar compression screws was used stopped using crutches and used a cane or a walker at a mean of 20 weeks after surgery. A statistically significant difference was seen when this figure was compared with the group of patients in whom the less invasive stabilization system was used, who used a cane or a walker at a mean of 9.6 weeks (p =0.01).

The Neer scale showed that excellent results were obtained in 59% of patients in Group I (21/36). The functional results in 9/36 patients were affected by the need to use a cane or a walker due to the severity of their pain. Additionally, 4/36 patients had a valgus deformity of less than 5°, and two

patients had a 10° rotational deformity together with a 10° valgus deformity. The results in 70% (16/23) of the patients in Group II were excellent; 6/23 patients had functional restriction due to the severity and ongoing nature of their pain. One patient (1/23) had a valgus deformity of less than 5°.

Discussion

Fractures of the distal femur are important injuries that regularly result in permanent disability. The magnitude of the functional loss results from the combination of injuries at the level of the distal femur, the articular cartilage and the surrounding soft tissues [17].

These fractures might comprehend the femur shaft with limited effects on the knee, or they may occur at the level of the supracondylar metaphysis and remain as extra-articular, although sometimes they go all the way to the attachments of the collateral ligaments (epicondyles). In other cases the fracture may compromise a single condyle (monocondylar fractures) with the other condyle and the shaft remaining intact. Often times the fracture is located at the supracondylar level, but it may extend inferiorly towards the articular surface with different degrees of comminution, as in supracondylar-intercondylar fractures [18].

Recently, the treatment of those fractures has evolved towards a balance between the mechanical stability of the fragments and also the biological viability, perceptive the principles of the anatomic reduction of the body part surfaces and also the restoration of the leg bone length, in addition as of the articular alignment and rotation [4, 19].

There are two well recognized patterns related with the mechanism of injury: high energy injuries in young patients and low energy injuries in older patients. It's acknowledged that 45% of the distal femur fractures occur as a result of minor trauma in osteoporotic bones, typically times when an elderly patient falls on a flexed knee [20].

In this paper we found that in patients treated with a plate with condylar compression screws, a high energy mechanism of fracture was predominant. Even though this may reflect a difference in the severity of injuries between the groups and may be a characteristic inherent to retrospective studies, so far there are no reports distinguishing between the treatment choice according to the mechanism of fracture and the results gathered for analysis purposes [21]. For this reason we consider that this reflects the transition towards a predominant management of distal femur fractures with less invasive techniques in patients with osteopenia in whom a low energy mechanism of fracture is involved. This is recommended by some authors, including Wong *et al.*, who published a series of 16 elderly patients with a mean age of 75 years, with a distal femur fracture, who were managed using a less invasive stabilization system. In their paper only two patients had loosening of the proximal fixation and in all cases healing was complete and was verified at postoperative week 30 as a mean. Therefore, these authors stated that this system was very effective for the treatment of this type of fractures in osteopenic bones [22].

The experiences of assorted authors have shown a shorter operative time and fewer injuries once the less invasive stabilization system was used compared to the plate with condylar compression screws. It's so no surprise that our study showed an equivalent. In fact, such comparative knowledge was obtained even with the minimally invasive placement of a plate with outgrowth compression screws [23].

An important data point found during this paper was the shorter time needed for the first mobilization of patients in whom the less invasive stabilization system was used, because the latter favors the first quality of patients for walking and flexing the knee, therefore avoiding the delay in convalescent the ranges of motion that results from muscle weakness.

On the opposite hand, 2/36 fractures with delayed healing were rumored within the patients treated with a plate with outgrowth compression screws, and 1/23 fractures with delayed healing within the cluster of patients treated with the less invasive stabilization system. Regarding consolidation, Jeon *et al* [23] rumored complete healing in ninety four of patients in sixteen fractures of the distal leg bone treated with a plate with outgrowth compression screws.

When the results were compared using the neer scale, no statistically significant difference was shown between both treatment modalities. However, it was seen that the prompt patient mobilization, the lesser soft tissue morbidity and the lower pain intensity are important factors for better patient outcomes with the less invasive stabilization system.

Conclusions

Overall, the treatment of distal femur fractures represents a special challenge for the orthopedist surgeon due to all the factors taken into account -such as the type of fracture, the bone quality, the time course and the overall status of the patient to obtain an appropriate postoperative course.

The plate with condylar compression screws involves a greater invasion of the soft tissues, which leads to more bleeding and the need for bone deperiostization for its placement. This increases the risk of postoperative complications in the elderly patients with a thin metaphyseal cortex and osteoporotic bone. Thus the use of the less invasive stabilization system is being preferred for the distal femur fractures that are usually caused by low energy mechanisms and where one expects to find osteopenic bone.

No significant differences were found in the degree of bone healing or in the recovery of the ranges of motion between both modalities.

During the overall evaluation of the results using the Neer scale, no significant difference was found based on the implants used. However, a significantly earlier mobilization was observed in the patients treated with the less invasive stabilization system, thus avoiding the possible complications that occur in patients who remain in complete rest for long periods of time.

The major factor influencing the results was the presence and severity of pain, which had direct repercussions on the patients' rehabilitation and their resumption of their activities.

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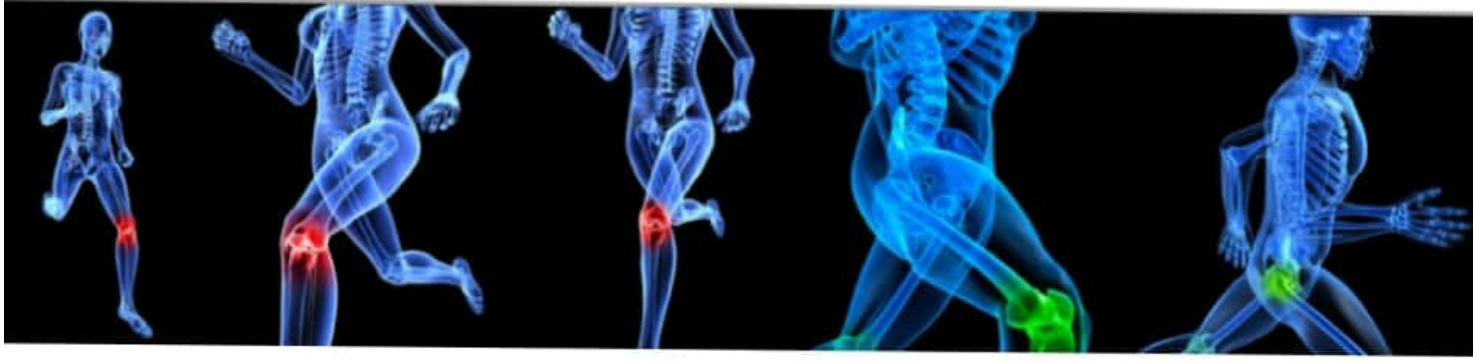

International Journal of Orthopaedics Sciences

Peer Reviewed Journal, Refereed Journal, Indexed Journal

ISSN: 2395-1958, Index Copernicus Value (ICV) 2015: 74.48

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This certificate confirms that **"Dr. Venugopal Palakurthi"** has published manuscript titled **"Comparative analysis of two different surgical treatments: Distal fermoral fractures"**.

Details of Published Article as follow:

Volume	:	**4**
Issue	:	**2**
Year	:	**2018**
Page Number	:	**819-823**

Certificate No.: **4-2-99**
Date: **01-05-2018**

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Dated: 09.11.2017

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Authors Name: Dr Venugopal Palakurthi, Dr. Srinivas Bachu
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JOE

Journal of Orthopaedic Education

May - August 2018
Volume 4, Number 2

Contents

Original Articles

Review Article

Original Article

Journal of Orthopaedic Education
Volume 4 Number 2, May - August 2018
DOI: http://dx.doi.org/10.21088/joe.2454.7956.4218.7

Study of Management of Intertrochanteric Fractures of Femur in Adults by Various Surgical Modalities

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Received: 01 November 2017 **Accepted on:** 09 November 2017

Abstract

Aim: To study the outcome of the various surgical modalities (DHS, PFN, Cemented bipolar arthroplasty) in the management of intertrochanteric fractures of femur in adults, compare the results, in various age groups, asses the complications encountered with each method. *Materials and Methods:* The present study consists of 50 adult patients with intertrochanteric fractures of femur treated with DHS, PFN and cemented bipolar prosthesis at department of Orthopaedics. *Results:* In this study of 50 patients, 14 were treated with PFN, 20 with DHS, 15 with bipolar hemiarthroplasty and 1 with other method. Intertrochanteric fractures common between 29-48 years and 49-78 years, shows bimodal age distribution. In young patients it was due to high velocity trauma, fall from height being the common mechanism of injury. Slip and fall was common mechanism in elderly. It was more common in females due to post menopausal osteoporosis. Associated injuries were more common in high velocity trauma. Early surgery increases patients comfort, facilitates nursing care, helps in early mobilization of patients and decreases hospital stay. *Conclusion:* In elderly patient with osteoporotic communited IT fracture, bipolar hemiarthroplasty is better option, Unstable, communited and reverse oblique IT fracture with good bone quality PFN is a better option. DHS is the still viable option in stable fractures and in unstable fracture with technical expertise, in improving fracture stability.

Keywords: DHS; PFN; Cemented Bipolar Arthroplasty.

Introduction

Intertrochanteric fractures are a major cause of morbidity and mortality in elderly population. The incidence of all hip fractures is approximately 80 per 100,000 persons. Intertrochanteric fracture make up 45% of all hip fractures [1]. Unstable intertrochanteric fractures in elderly patients are associated with high rates of morbidity and mortality [2] although the results have improved with the use of internal fixation. In these patients however, comminution, osteoporosis, and instability often preclude the early resumption of full weight bearing [3]. Trochanteric fractures almost invariably occur as a result of fall, at involving both direct and indirect forces. Koval [4] and Zuckerman postulated that Intertrochanteric fractures constitute almost half of all fractures of the proximal femur. Direct forces act along the axis of the femur or directly over the greater trochanter to result in Intertrochanteric fractures. Indirect forces include pull of the iliopsoas muscle on the lesser trochanteric and pull of the abductor muscle on the greater trochanteric region. Intertrochanteric fractures, are commonly encountered in patients over 60 years of age and are three times more frequent in women than men because women tend to be less active and develop

postmenopausal osteoporosis. Severe osteoporosis in these age group is responsible for high incidence with minimal to moderate trauma. Norton and Riska described patients with Intertrochanteric fractures to be 10 to 12 years older than patients with intracapsular femoral neck fractures, the average age reported in these patients in 60 to 75 years [5]. Intertrochanteric fractures frequently occur through bone affected by osteoporosis, the degree of osteoporosis can be determined by singh's index, which classifies the severity of osteoporosis by the radiographic evaluation of trabecular pattern [6] of the proximal femur.

Before the introduction of suitable fixation devices, treatment for intertrochanteric fractures was non operative, consisting of prolonged bed rest in traction until fracture healing occurred (usually >12 weeks), followed by a lengthy program of ambulation training, was associated with high complication rates, like decubiti, urinary tract infection, joint contractures, pneumonia, atelectasis and thromboembolic episodes and locally fracture malunion with varus deformity and shortening leading to high morbility. Surgery in trochanteric fractures is important in elderly patients for prevention of complications associated with conservative treatment and aimed at early rehabilitation and mobilization. Internal fixation does provide stability, but in elderly patients with osteoporotic bones, complications like loosening, implant penetration, loss of fixation, cut through of implant are not uncommon, thus is the emerging role of cemented bipolar in the management of intertrochanteric fractures.

Materials and Methods

The present study consists of 50 adult patients with intertrochanteric fractures of femur treated with one of the procedure, DHS, PFN and cemented bipolar prosthesis, followed up at regular intervals with minimum follow up of 6 months.

Data Collection

After admission of patient, clinical details, and investigations were taken, necessary was performed, discharged , followed up at regular intervals for serial clinical and radiological evaluation.

Inclusion Criteria

All patients with intertrochanteric fractures with age > 18 years.

Exclusion Criteria

Young patients age < 18 years, elderly patients with severe medical problems, unfit for anaesthesia.

Management of Patient

After patient's aadmission, necessary clinical and radiological evaluation was done and admitted with necessary resuscitation and splintage with skeletal traction.

The following Investigations were done routinely on all these patients. Blood Hb%, Bleeding time, Clotting time, Blood grouping and Cross matching, Fasting and Post prandial blood sugar, Blood urea and Serum Creatinine, Urine Albumin, Sugar, microscopic examination. X-ray Pelvis with both hips (AP view), Chest X ray PA view. All the patients were evaluated for associated medical comorbidities and associated injuries (if any) were treated simultaneously. The patients were operated on elective basis after overcoming the avoidable anaesthetic risks.

Pre-Operative Planning

Ap X Ray Involved Hip And Traction Views Are Taken singhs index assessed, age of the patient and fracture geometry were considered in the selection of the treatment modality.

Geriatric patients(>65years) with unstable fracture and singhs index <4 — cemented bipolar

Unstable fractures with subtrochanteric extension and reverse oblique types — proximal femoral nail. All simple and stable fractures - dynamic hip screw.

Pre-Operative Treatment

After PAC, written informed consent taken, local part preparation, prophylactic antibiotics were given.

Surgery: after SA, patient is mounted on fracture table, fracture reduction is checked in c-arm image, if it is simple and stable, DHS is performed, If fracture is unstable and comminuted, reduction is achieved and PFN is performed.

In both procedures, final image is checked. In cases already decided for bipolar prosthesis, after SA, lateral position, aseptic, posterio lateral approach, fracture is approached, head extracted, neck is prepared rasped, measured head size bipolar is inserted after cementing, with length and anteversion and offset were taken in to consideration, grater trochanter is stabilised (TBW), soft tissue repair was done meticulously.

Post Operative Treatment

Iv fluids,antibiotics,drain monitoring and dressings were performed, gradual mobilisation as per fracture stability were performed.

Results

It is a non randomised prospective, observational study, with sample size of 50.

Table 1: Incidence

Age group	No. of Patients	Percentage
18—28	1	1.33%
29—38	2	4%
39—48	5	8%
49—58	11	17.33%
59—68	17	38.67%
69—78	11	1.33%
79—88	2	8%
89—98	1	1.33%
Sex		
Female	28	56%
Male	22	44%
Side involved		
Left	27	54%
Right	23	46%

Table 2: Injury, fracture, surgical procedure

Mode of Injury	No. of Patients	Percentage
fall on slippery floor	30	60%
fall from stairs & height	10	20%
RTA	7	14%
Other	3	6%
fracture type (Evans classification)		
Stable	12	24%
Unstable	38	76 %
surgical procedure		
dynamic hip screw	20	40%
proximal femoral nail	14	28%
cemented bipolar	15	30%
others	1	2%
hospital stay duration in days		
10-15 days	31	62%
16-20 days	11	22%
>21 days	8	16%

Table 3: Average blood loss, full weight bearing duration

Operative procedure	Cemented bipolar	PFN	DHS
Blood loss	200 ml	100 ml	250 ml
Full Weight bearing	6 weeks	8 weeks	12 weeks

Table 4: Surgical outcome

Outcome	Cemented Bipolar		PFN		DHS	
	N	%	N	%	N	%
Excellent	12	80	13	92.96	17	85
Fair	2	13.33	1	7.14	1	5
Poor	1	6.67	0	0	2	10

In this study out of 15 patients of bipolar hemiarthroplasty, 12 (80%) had excellent outcome , 2 (13.33), 1 (6.67%%), had, fair and poor outcomes respectively. Out of 14 patients of PFN, 13 (92.96%) had excellent and 1 patient (7.14%) had fair. Out of 20 patients of DHS, 17 (85%) patients are excellent results, 1 (5%) patient had fair and 2 (10%) patients had poor results.

Table 5: Post-operative complications in 3 surgical modalities

Complications	No. of patients	percentage
dynamic hip screw group		
loss of reduction	0	0
screw cut out	0	0
varus malunion	1	5%
screw back out	1	5%
non union	0	0
implant cut out	1	5%
proximal femoral group		
Complications		
implant failure	0	0
superficial infection	1	7.14%
screw back out	1	7.14%
thigh pain	0	0
non union	0	0
peri prosthetic #	0	0
cemented bipolar group		
Complications		
dislocation	0	0
superficial infection	1	6.67
limb shortening	1	6.67
limb lengthening	1	6.67
peri prosthetic #	0	0
aseptic loosening	0	0

Clinical Case 1: Bipolar arthroplasty

Pre Operative

Post Operative

IT #, geriatric, unstable comminuted, osteoporotic

Follow up after 6 months

Case 2: Dynamic hip screw (DHS)

Pre Operative X-ray IT #, stable

Immediate Post Operative

6 months Post-Operative

Clinical photos

Case 3: Proximal femur nail

Pre op- IT #,unstable

1 month follow up

3 months follow up

Clinical photos

Discussion

The treatment of intertrochanteric fracture is still associated with some failures. High stress concentration that is subject to multiple deforming forces, high incidence of complications reported after surgical treatment, compels the surgeon to give a second thought regarding selection of proper implant.

DHS: The simple, most commonly used method of fixation is sliding screw system for stable fractures. Unstable fractures requires stabilising procedures like Dimon and hughston Osteotomy which is major procedure and needs expertise.

PFN: The AO ASIF in 1996, therefore developed the Proximal Femoral Nail with an antirotation hip pin together with a smaller distal shaft diameter which reduces stress concentration to avoid failures. From mechanical point of view an intramedullary device inserted by means of minimally invasive procedure seems to be better in elderly patients. Closed reduction preserves the fracture heamatoma, an essential element in consolidation process. Intramedullary fixation allows the surgeon to minimize soft tissue dissection, there by reducing surgical trauma, blood loss, infection and wound complications.

Bipolar Hemiarthroplasty: Unsatisfactory surgical outcome is common in elderly patients with intertrochanteric fracture fixation methods, existing medical illness, osteoporosis, and fracture instability being contributing factors, may lead to loss of reduction, malunion, implant breakage. In order to give early mobilisation to decrease the risk of mortality and morbidity, we preferd cemented bipolar hemi arthroplasty for the treatment of osteoporotic, unstable trochanteric fractures in the elderly. outcome was evaluated with harris hip score .

On Comparision with Other Studies

Age Incidence: The average age in our series was 65 years with a range of 18-98 years. The average age in Casey MD series 2000 was 84.2 years and Heidelberg 2002 was 75.6 years. The age incidence in our series is at lower side, probably due to malnutrition, early onset of senile osteoporosis in our country. The average life expectancy of an Indian is 10 years less than western standards.

Sex Incidence: In our series, male to female ratio was 44:56. is similar to the reported series. According to Long and knight [16] females were 65.38%. In our study also IT fracture common in elderly female in post menopausal age and associated osteoporosis.

SIDE Incidence: 23 (46%) patients had fracture on right side and 27 (54%) patients had fracture on left side.

Fracture Patern: Evans unstable fractures were more accounting for 76%. In our study, intertrochanteric fracture was common due to fall on a slippery surface.

Type of Surgery and Outcome: In our study, 88% good and excellent results were noted with bipolar hemiarthroplasty comparable to other studies conducted by Rosenfeld et al. [12] used arthroplasty and reported 86% satisfactory results in the early period. Haentjens et al. [6] compared the clinical results of internal fixation and bipolar arthroplasty for unstable trochanteric fractures and reported 75% satisfactory results and less postoperative

complications in the latter group. They insisted that early weight bearing was the major factor responsible for decreasing postoperative complications. K. Casey Chan and Gurdevs Gill [7] found that use of standard cemented hemiarthroplasty is a reasonable alternative to a sliding screw device for the treatment of intertrochanteric fractures to achieve less postoperative complication. Prof. Chris Grimsud, Raul J. Monzon [8] treated all unstable three and four part hip fractures with standard femoral stem and circlage cabling of trochanters and they conclude that bipolar arthroplasty allows safe early weight bearing on the injured hip and had a relatively low rate of complication

Hospital Duration: A study of 50 patients of unstable intertrochanteric fractures treated with PFN, DHS & Bipolar by other studies (2004), they found duration of stay for PFN and DHS were 14 and 22 days, blood loss was 275 and 475ml, This correlated with our study where the duration of hospital stay was 14 days, average blood loss was100 and 250 ml.In bipolar hemiarthroplasty, hospital stay was avg 10 days and avg blood loss was 200ml. This correlated with our study where the restoration of post op walking ability was faster in pfn, bipolar hemiarthroplasty when compared with DHS.

Post Operative Complications: We noted one superficial infection in our study, with regular aseptic dressings and culture directed antibiotics the infection subsided Dislocation of the bipolar prosthesis is not seen our study, may be due to adeaquate and optimal repair of abductor mechanism by meticulous suturing of vastus – gluteal complex. Mericevic A et al. [9] study dislocation was seen in 2.6% patients, loosening seen in 1.3% patients, infection 2.3% intra hospital mortality in 1.3% patients in Bipolar Hemiarthroplasty. We noted shortening of less than 2cm in 1 of patients and limb lengthening in 1 of patients .this is because of excessive comminution of the fracture. We noted screw backout in 2 patients, 1 in DHS and 1 in PFN may be due to osteoporosis. varus malunion in 1 patient, implant failure in 1 patient, both of which occurred with DHS. This may due to imperfect fixation and incorrect selection of patient. i.e. osteoporotic.

Nuber S et al. [10] compared the dynamic hip screw (DHS) with trochanteric stabilisation plate (TSP) as the extramedullary power transmission system and the proximal femur nail (PFN) as the means of intramedullary stabilisation are both standard in the treatment of unstable trochanteric femoral fractures. At low complication rates, the radiological operation results are equally good. 6 revisions were necessary in the case of the DHS with TSP and 4 in the case of PFN. A significantly shorter operation time (44.3 vs. 57.3 min) and a considerably shorter in-patient stay (18.6 vs. 21.3 days) were common with PFN. The application of full-weight bearing immediately after the operation was possible for 97% of the PFN patients and 88% of the DHS patients. In a follow-up 6 months after the operation, the PFN patients displayed a significantly lower pain intensity in the operated leg at the same score for ambulation and the same subjective degree of satisfaction,hence recommonded PFN.

Parker MJ et al. [11] compared all cephalocondylic intramedullary nails with extramedullary implants for the surgical treatment of extracapsular hip fractures in adults. The one trial of 230 patients comparing the Kuntscher-Y nail with the SHS, reported no major difference the outcome aside from a significantly increased number of patients with leg shortening, and a tendency for poorer recovery of mobility in the Kuntscher-Y nail group. Five trials involving 603 patients compared the intramedullary hip screw (IMHS) with the SHS. Fracture fixation complications were more common in the IMHS group: all cases of operative and later fracture of the femur occurred in this group. Results for post-operative complications, mortality and functional outcomes were similar in the two groups. Two under-reported trials tested the proximal femoral nail (PFN).

The results of one study of 206 patients with a trochanteric fracture showed no advantages for the PFN compared with the SHS. The other study, involving 39 patients, comparing the PFN with the dynamic condylar plate for treating more distal and uncommon trochanteric fractures gave better intra-operative and fracture fixation results for the PFN. One trial of 60 patients reported favourable preliminary results for an experimental mini-invasive static intramedullary nail compared with the SHS.

Conclusion

In elderly patient with osteoporotic bone, communited IT fracture, cemented bipolar hemiarthroplasty is better option. Unstable (reverse oblique, sub trochanteric extension), communited fractures with good bone quality, PFN is a better option .

DHS is the still viable option in stable fractures and as well as unstable fracture with technical expertise.

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European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 02, 2022

Original Research Article

To distinguish between the results of early and delayed arthroscopic reconstruction of anterior cruciate ligament tears

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Abstract

Objective of the Study: This study's main goal is to evaluate the functionality of early and delayed arthroscopically reconstructed ACLs using the IKDC score, Lysholm-Tegner score, KOOS scoring, as well as clinical testing such as the pivot shift test, anterior drawer test, Lachmann test, and range of motion both before and after surgery.

Need for the Study: Reconstructing the anterior cruciate ligament (ACLR) increases the stability and functionality of the knee. Numerous contentious concerns, including graft selection, surgical technique, and scheduling of operation, are present and the surgical approach is still evolving. The best moment for reconstructive surgery following injuries is a topic of debate. Few authors have advocated for reconstruction within 12 weeks. Early surgical intervention may reduce the likelihood of meniscal and chondral damage and prevent the knee from becoming more unstable. Other studies concluded that early repair would have unexpected results because of discomfort, arthrofibrosis, and patellar contracture syndrome and advised waiting until 12 weeks had passed before having surgery. This research will assist the surgeon in arthroscopically reconstructing the anterior cruciate ligament at the ideal time.

Methods: After receiving informed consent, 60 patients with ACL injuries who were admitted to Govt. Medical College & Hospital were enrolled in this study. There was a thorough clinical examination and history taken. Magnetic Resonance Imaging (MRI) and routine clinical tests were used to confirm the diagnosis (Sigma HDxT-GE 1.5 Tesla). Depending on the time of hospital presentation, patients with total or partial ACL Tears having ACL reconstruction were randomly assigned to early 12-week groups x. These patients had arthroscopic ACL reconstruction using semitendinosis and gracilis triple grafts in order to repair their established ACL tears, either partial or total. IKDC score, Lysholm-tegner score, and KOOS scoring were used to evaluate the functional performance of the rebuilt ACL over a period of 6 to 1 year.

Results: Clinical and functional scores post-operatively improved statistically significantly in both the Early and Delayed groups. In both groups, the score improvement was comparable. The improvement in pain ratings, range of motion, anteroposterior stability, and functional scores between the early and delayed groups did not vary statistically. There were no notable variations between the two groups' improvements.

Keywords: Arthroscopic reconstruction, anterior cruciate ligament tears, surgery

Introduction

The anterior cruciate ligament (ACL) has gained popularity over the past ten years. The majority of athletes has either heard of it or knows someone who has suffered an ACL injury. The anterior cruciate ligament is widely known for playing a crucial part in the kinematics of the knee and contributes significantly to the stability of the knee joint [1]. Therefore, the regular day-to-day activities of the average person are significantly impacted by the restoration of the anterior cruciate ligament (ACL). Nowadays, one of the most common knee surgical operations is the reconstruction of the anterior cruciate ligament (ACL). The knee's stability and functionality are improved with anterior cruciate ligament restoration (ACLR) [2]. Numerous contentious problems still surround the surgical procedure, including the choice of the graft (patellar tendon, hamstring, quadriceps, or allograft), surgical technique (double versus single bundle), femoral tunnel drilling, and the precise timing of the procedure. Young athletes frequently suffer from anterior cruciate ligament (ACL) tears, which put the knee at risk for further damage and possibly for the earlier start of osteoarthritis (OA) [3]. The preferred course of treatment for young patients who want to continue playing sports is ACL reconstruction. Reduced post-surgical morbidity and shorter absences from work and leisure activities are the results of arthroscopic methods. In the beginning, patients were frequently rebuilt within the first week following the accident, which occasionally led to a stiff joint [4]. Therefore, it was indicated that postponing the procedure might reduce the chance of developing arthrofibrosis. The benefits of early reconstruction, on the other hand, have been emphasised; they include a shorter period of aberrant knee kinematics and instability and, consequently, less meniscal and cartilage damage due to recurring pivoting trauma while waiting for surgery. Currently, the majority of surgeons concurs that before to reconstruction, the patient should have restored complete range of motion (ROM) and exhibits no symptoms of arthrofibrosis or quadriceps atrophy. There is still no agreement on the best time to have an ACL reconstruction [5]. The study's objective was to compare the outcomes six months after anterior cruciate ligament (ACL) reconstruction using a hamstring tendon (HT) autograft in patients who underwent surgery within 12 weeks of the injury (Group A) and patients who underwent surgery more than 12 weeks later (Group B) [6].

Anatomy: During the eighth week of the human embryo, a gap forms between the mesenchymal rudiments of the femur and tibia, forming the knee joint [7]. Vascular mesenchyme is segregated within the joint as the mesenchyme in the area of the future knee joint condenses to produce the pre-cartilage and the joint capsule. The cruciate ligaments and the menisci develop from this tissue. The long axes of the many immature fibroblasts that make up the cruciate ligaments at 9 weeks are parallel to the direction of the ligaments. ACL and PCL are separated from one another at 10 weeks, and over the following 4 weeks, the cruciate ligaments continue to distinguish from the surrounding tissues and the insertion sites become more clearly defined. By 18 weeks, the cruciate ligaments are virtually completely by themselves, and some vascular components can be seen within their structure. The ACL continues to grow and become more vascular during the following weeks, eventually resembling the adult ACL. The remaining development is characterised by significant expansion but little shape change. The mature ACL links the femur and tibia with a band of dense connective tissue that is consistently orientated. The anterior and posterior cruciate ligaments are entirely encircled by a fold of synovium that comes from the posterior intercondylar region of the knee. The cruciate ligaments are hence extrasynovial and intraarticular [8]. The medial surface of the lateral femoral condyle's posterior aspect has a fossa where the ACL is attached. The attachment has a semilunate shape, with a convex posterior border and a straight anterior border. The femoral attachment's long axis measures around 23 mm in length and is angled just slightly forward of vertical [9]. The ACL is joined

to a fossa on the tibia that is lateral and anterior to the anterior tibial spine. The transverse meniscal ligament is underneath the anterior portion of the tibial attachment, and some ACL fascicles may converge with the lateral meniscus' anterior attachment. The ACL's tibial attachment is a little bit wider than its femoral attachment. It is around 30 mm long. The ACL is fan-shaped as a result of the tibial attachment being a little larger than the femoral. From the femur to the tibia, the ACL travels anteriorly, medially, and distally over the joint. The bony attachments give it a small outward (lateral) spiral shape as well. The ACL's cross-sectional area fluctuates along its length, being bigger at its insertion sites than in the mid-region, although having an average thickness of 11 mm. The range of the typical length is between 31 and 38 mm [10]. Current reconstruction techniques cannot replicate the intricate geometry of the ACL. The ACL's front border has the longest fibres, while its posterior margin has the smallest. As the ACL is stressed, its distinctive crimp pattern straightens. The anteromedial (AMB) and posterolateral (PLB) bundles have been split into the ACL, which has no anatomically distinct bundles but has been functionally divided into at least two bundles that cooperate to maximise its restraining function throughout the range of knee motion [11]. The direction of the ACL's femoral connection in flexion and extension is what keeps the ligament taut throughout its range of motion. The ACL is connected to the femur and tibia by a network of distinct fascicles that spread out over a sizable, flattened region. The entire ligament is taut when the knee is extended, with the PLB bearing the majority of the strain. The AMB tightens and the PLB relaxes during flexion because the femoral connection of the ACL acquires a more horizontal orientation [12]. Additionally, a middle bundle is described. This is thought to be the cause of the knee's straight anterior stability. These macroscopic bundles in the ACL's content do not, however, have a comparable substructure. The fact that groups of fascicles cooperate across the range of joint motion gives the ACL's fascicles their functional relevance [14]. The extracellular matrix that surrounds the fibroblasts that make up the ACL is made of a solid, meticulously arranged mixture of macromolecules, mostly type I collagen and water. The matrix's make-up, the macromolecules' arrangement, and their interactions with water all affect the ligament's mechanical characteristics. As with ageing, minor modifications to this composition could result in modifications to its mechanical properties [15]. The ACL is made up of collagen fibrils that range in size from 30 to 175 nm and are organised in parallel microscopically [16]. These fibrils are then gathered into fibres, which range in diameter from 1 to 20 micrometres. They virtually parallel the ligament's long axis. These fibre bundles combine to create subfascicular units, which have a diameter between 100 and 250 micrometres. A collagen fasciculus with a diameter of several millimetres is made up of 3 to 20 subfasciculi. The ligament's bands could not be anatomically distinguished by Clark and Sidles. The ACL differs from other ligaments surrounding the knee in this regard [17]. The ACL has a matrix comprised of a network of proteins, glycoproteins, elastic systems, and glycosaminoglycans with complex functional relationships, as well as a microstructure made of collagen bundles of various types (mainly type I). The ACL can sustain multiaxial stresses and different tensile strains due to its extensive elastic system and sophisticated ultrastructural organisation [18]. The medial and lateral inferior genicular arteries, as well as a few of their terminal branches, provide portion of the medial and lateral ACL's blood supply [19]. The synovial fold that encloses the ACL is reached by these vessels. They grow into a web-like network of periligamentous vessels in this synovium, which anastomoses with a network of endo ligamentous vessels to generate smaller connecting branches that transversely puncture the ligament. These are longitudinally oriented and parallel to the collagen bundles in the ligament, along with the connective tissue that supports them [20]. Both experimental and clinical research have shown the importance of the vascular tissues in ACL healing and regeneration. According to Bray *et al.*, the medial collateral ligament's (MCL) greater ability to enhance its blood supply through angiogenesis and increased flow is crucial for ligament healing and may account for the majority of the

healing potential differential between the MCL and ACL. Revascularization of ligaments that have been healed may occur from the synovium or the fat pad, respectively [21]. In dogs without bone tunnels, revascularization starts at 6 weeks and is finished 20 weeks after surgery. During the first two years following reconstruction, Howell et colleagues used MRI and an intravenous contrast agent (gadolinium diethylenetriamine pentacetic acid) to assess the blood supply to hamstring autografts and periligamentous tissues [22]. They discovered that the grafts did not develop any discernible blood supply within the first two years, and they continued to seem hypovascular like a typical PCL. By one month after surgery, the periligamentous soft tissues had a rich vascularization and were covering the transplant. They came to the conclusion that synovial diffusion may be more important to the grafts' viability than revascularization. Branches of the tibial nerve that enter the joint posteriorly send nerve fibres to the ACL. Neurovascular bundles made up of nerve fibres and sensory receptors enter the ligament from the synovium and follow the vessels [23]. The ligament also houses a number of sensory end organs and some nerve fibres that are separate from the vessels. There are two types of nerve fibres, unmyelinated and myelinated, and four different types of sensory endings have been identified based on their morphology. Pacinian corpuscles and free nerve endings are the two different categories of Ruffini end organs. These nerve terminals are thought to play a significant proprioceptive role in the knee [24]. The number of mechanoreceptors and the precision of the joint position sensation were found to be positively correlated by Adachi *et al.* (20), indicating that the quantity of mechanoreceptors affects the proprioceptive function of the ACL [25].

Materials and Methods

Design of the study

In this study, which was conducted between September 2019 and September 2021 [26], 60 patients between the ages of 18 and 60 who had symptomatic ACL tears that required arthroscopic restoration were admitted to Govt Medical College & Hospital.

Sample size

Sixty patients diagnosed to have acute and chronic ACL injury will be included using purposive sampling technique.

Design of the study

Prospective cohort study.

Method of collection of data

After receiving informed consent, 60 ACL damage patients who were admitted to Govt Medical College & Hospital, Siddipet were enrolled in this study. There was a thorough clinical examination and history taken. Standard clinical tests and radiograph Magnetic Resonance Imaging (MRI) were used to confirm the diagnosis (Sigma HDxT-GE 1.5 Tesla). Depending on the time of hospital presentation, patients with total or partial ACL Tears having ACL repair will be randomly assigned to early 12-week groups. These individuals will have arthroscopic ACL restoration using semitendinosis and gracilis quadraple grafts if they have an established ACL injury (partial or total). At the department of orthopaedics at Govt Medical College & Hospital, functional evaluation of the repaired ACL will be done using the IKDC score, Lysholm-tegner, and KOOS scoring between a period of 6 months and 1 year once post-operatively. Additionally, the grading will be compared to results from the

anterior drawer test, Lachmann test and knee range of motion [27, 28].

Inclusion criteria

1. Patients with complete or partial ACL Tear who are undergoing
2. ACL reconstruction.
3. Patients belonging to the age group of 18-60 years with ACL injury
4. either isolated or
5. Acute or Chronic
6. Associated Meniscal injury
7. Medial collateral ligament injuries (Grade 1, 2)
8. Lateral collateral ligament injury (Grade 1, 2)
9. Chondral injury (Grade 1, 2)

Exclusion criteria

1. Patients with associated Posterior Cruciate Ligament (PCL) injury.
2. Patients with ACL re-injury.
3. Patients with associated per articular fracture.
4. Patients with associated ipsilateral lower limb fracture.
5. Grade 3 & 4 chondral injuries (detec ted intraoperatively)
6. Medial and Lateral Collateral li gament injury (Grade 3 and 4).

Procedure

All the patients diagnosed to have an ACL injury clinically underwent a MRI of the affected limb. Once the diagnosis was established, in acute stage long knee brace, anti-inflammatory medications, started on quadriceps strengthening exercises and once the tissue swelling subsided and no extension lag patient was taken up for surgery. Patient was admitted one day prior to surgery and preoperative blood tests were done. The patient underwent a pre anaesthetic checkup for fitness. Parts were prepared and a written and informed consent for the surgery was taken [29].

Surgery

Patient was shifted to the operation theatre and was given a spinal/ epidural anaesthesia.

Examination under anaesthesia

Under spinal and epidural anaesthesia the knee join t was assessed clinically for Lachman test, Anterior Drawer test, Pivot shift was graded accordingly. In cases where clinical examination and MRI was inconclusive, but patient was symptomatic, decision to do ACL was taken based EUA and arthroscopic findings [30].

Surgical steps

- Under anesthesia, pneumatic tourniquet was applied over the thigh as it has advantage of increased visibility and shorter duration of surgery.
- Patient was positioned supine
- Parts drapped by standard method to allow manipulation of the limb and cleaned.
- Standard anterolateral and anteromedial portal made.

- With 25-and 30-degree arthroscope diagnostic arthroscopy done and looked for

1. Suprapatellar pouch and patellofemoral joint
2. Medial gutter
3. Medial compartment
4. Intercondylar notch
5. Posteromedial compartment
6. Lateral compartment
7. Lateral gutter and posterolateral compartment

Results

Preoperative data analysis included clinical test evaluations of the Lachman's test, Anterior Drawer test, Pivot shift, X-ray and MRI of the knee, IKDC score, Lysholm-Tegner scoring, and KOOS scoring. The functional analysis of post-operational data used the IKDC, Lysholm-Tegner score, and KOOS scoring. Post-operative pivot shift tests, anterior drawer tests, and Lachman's tests. Mean + or - SD was used to express the scores at both time points. The data's normalcy was investigated. Using a paired student t-test, the scores, which had a normal distribution, were compared between the pre- and post-operative time points. At P 30 kg/m2, every statistical analyses was deemed significant. Graft failure was possible.

Table 1: Groups

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
1	30	50	50	50
2	30	50	50	100
Total	60	100	100	

Table 2: Age

Age	Years (Average)
Early	32
Delayed	29
Total	30

Table 3: Sex

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Male	56	93.3	93.3	93.3
Female	04	6.7	6.7	100
Total	60	100	100	

Table 4: Body Mass Index kg/m2

Group	kg/m2
Early	24.73
Delayed	25.056
Average	24.893

Table 5: Mode of injury

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
RTA	14	23.3	23.3	23.3
Self-fall	18	30.0	30.0	53.3
Sports	28	46.7	46.7	100.0
Total	60	100.0	100.0	

Table 6: Isolated ACL tear

Diagnosis					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ACL+	60	100.0	100.0	100.0
	ACL	25	41.7	41.7	41.7

Table 7: ACL with medial meniscus tear

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	49	81.7	81.7	81.7
MM	11	18.3	18.3	100.0
Total	60	100.0	100.0	

Table 8: ACL + Lateral meniscus tear

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	46	76.7	76.7	76.7
LM	14	23.3	23.3	100.0
Total	60	100.0	100.0	

Table 9: ACL + both meniscal tears

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50	83.3	83.3	83.3
Both	10	16.7	16.7	100.0
Total	60	100.0	100.0	

Table 10: Intraoperative chondral changes

	Frequency	Percent	Valid percent	Cumulative percent
Early	04	13.33	22.22	22.22
Delayed	14	46.66	77.78	77.78
Total	60	30		100

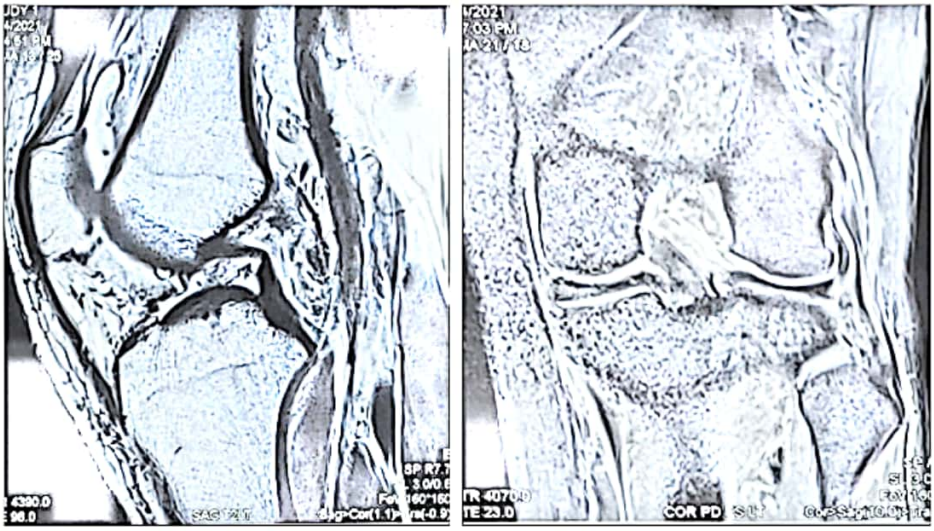

Fig 1: MRI Images of Knee

ISSN 2515-8260 Volume 09, Issue 02, 2022

Fig 2: Graft Harvesting

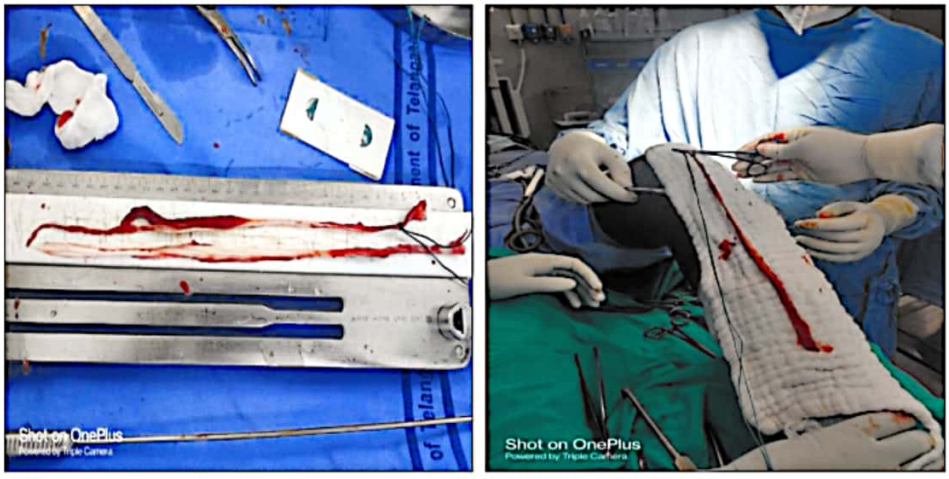

Fig 3: Graft Preparation & Tensioning

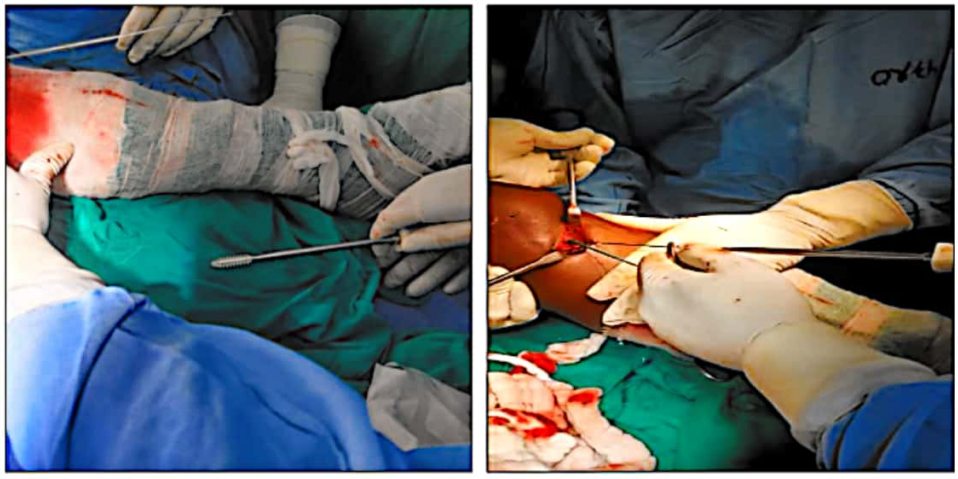

Fig 4: Graft Fixation

Fig 5: Post-operative Stability check

Discussion

In our study, there were 60 total patients, 30 of them were in the early group and 30 in the delayed group. There is no statistically significant difference in patient ages between the two groups. Patients in groups 1 and 2 were on average 32 and 29 years old, respectively. In terms of patient sex distribution, there is no statistically significant difference between the two groups. In our investigation, the patients were mainly men. The body mass indices of the two groups are statistically identical. Group 1's BMI is 24.73, while Group 2's is 25.056. No statistically significant difference existed between the parties involved in the knee injury.

There was a noticeable difference in the two groups' injury modes. Sports injuries were the most frequent type of injury in both groups, accounting for 46% of patient injuries, followed by domestic occurrences like self-falls and traffic accidents. Meniscal damage was significantly different between groups, with group 2 demonstrating more damage than group

1. Comparatively speaking, Group 2 had more medial meniscus injuries than did Group 1. The functional scoring, however, did not show a statistically significant difference. 25 patients had an independent ACL rupture, 12 in Group 1 and 13 in Group 2, while 11 patients had an accompanying medial meniscus tear, of which 4 were in Group 1 and 7 were in Group
2. Along with ACL tears, lateral meniscus tears were observed in 14 patients; 8 of these patients were in group 1 and 4 were in group 2.

Ten individuals had combined meniscal tears on both sides. One patient had a minor tear of the medial collateral ligament. During the trial period, there were no complications including infection, haemorrhage, stiffness, or graft failure. When compared to pre-operative scores and clinically, there was a statistically significant improvement in the subjective IKDC, Tegner & Lysholm, KOOS ratings, clinically improved knee range of motion, and no indication of instability post-operatively in both groups. But there were no appreciable variations in the functional outcome. However, although group 1 had a larger score difference, statistical significance is not apparent.

Eight patients had grade 1 Lachmann and grade 1 anterior drawer's tests at more than six months of follow-up. They received no complaints about instability, though.

IKDC score for Group 1 was 38.67 at admission and 81 at the end of six months.

IKDC score for Group 2 was 41.72 at admission and 84 at the end of six months. The T & L

score for Group 1 was 49.78 upon admission and 93.5 after six months. The T & L score for Group 2 was 48.32 upon admission and 91.54 after six months. The KOOS Symptoms score for Group 1 was 59.15 upon admission and 90.34 after six months. The admissions KOOS symptoms score was 61.03 and was 88.23 after six months for Group 2. The KOOS pain score for Group 1 was 60.04 upon admission and 92.67 after six months. The KOOS pain score for Group 2 was 59.80 upon admission and 92.88 after six months. At the time of admission, Group 1's KOOS activity of daily living score was 61.40, and it was 91.67 at the end of six months. At the time of admission, Group 2's KOOS activity of daily living score was 59.80, and it was 95.21 at the end of six months. For Group 1, the KOOS sports score was 43.93 at admission and 79.27 after six months. The KOOS sports score for Group 2 was 30.32 upon admission and 80.25 after six months. At the time of admission, Group 1's KOOS quality score was 36.21, and it was 70.34 after six months. At the time of admission, Group 2's KOOS quality score was 36.60, and it was 73.16 after six months. The KOOS total score for Group 1 was 53.70 at admission and 88.43 after six months. The KOOS total score for Group 2 was 55.06 upon admission and 89.49 after six months.

In our study, there was equivalent activity level, age, BMI, sex, and injury mode between the groups. There were no discernible differences in related injuries across the groups. 95 to 100 is considered to be an exceptional Lysholm activity score, 84 to 94 acceptable, 65 to 83 medium, and 65 poor [31]. The Lysholm score was so favourable for both Groups A and B. At the follow-up, there were no discernible differences between the groups in terms of ROM or the one-leg hopping test while kneeling. Both groups could engage in recreational sports activity, but the patients in Group A could do so at a higher degree. Lysholm score and Tegner activity level did not differ between early (within 3 weeks) and delayed reconstruction (after 6 weeks) in a 2009 Smith *et al.* review [32] comparing the outcomes of early versus delayed surgery for ACL reconstruction generally. Their groups were separated by a different amount of time than in the current study, though. In subacute and delayed reconstructions employing the bone-patellar tendon-bone (BPTB) autograft, Karlsson *et al.* [33] compared the results. Their investigation found higher levels of Tegner activity in the group who received subacute reconstructions, which was consistent with our findings at the two-year follow-up. The time period for the subacute and delayed groups in their study was comparable to ours before 12 weeks and after 12 weeks. Additionally, Karlsson *et al.* [34] reported that the delayed group suffered greater meniscal injuries, a finding that was also documented by other authors. [35] Meniscal injury enhances the chance of developing OA in the knee, as does a meniscal injury coupled with an ACL injury, as was also observed in our study. Meniscectomy and chondral injury were found to be the two most important predictors of the onset of OA, according to Keays *et al.* They also discovered that employing BPTB autografts compared to HT autografts resulted in a lower risk of developing OA, a conclusion that is also agreed upon by others. There are studies that, however, do not differentiate between the various grafts and the development of OA [36].

In a research by Levy and Meier, patients with conservatively treated ACL injuries had a 40% incidence of meniscal tears at year 1, a 60% incidence at five years, and an 80% incidence at ten years following the index injury. Similar trends were observed in the current investigation, where the incidence of medial meniscal tears at the index procedure was 33% in Group A and 60% in Group B. However, the difference was not statistically significant, which may have been caused by the inadequate patient population (type 2 errors). According to Jomha *et al.*, meniscectomy rates were greater in chronically injured knees than in acutely injured knees at the time of ACL repair. These authors assert that meniscectomy is more frequently necessary in ACL-deficient knees that experience recurring trauma, such as small translations and significant instances of giving way. Other authors have also reported on this. An isolated ACL injury without accompanying meniscal damage appears to have a low incidence (0–13%) of radio graphically evident knee OA, according to seven prospective and

24 retrospective studies assessing the prevalence of OA more than 10 years after an ACL injury. ACL and meniscal injuries together were associated with a greater reported prevalence of knee OA (21–100%) in the participants. The same study also revealed that long-term prevention of knee OA cannot be achieved by ACL restoration alone. When employing the BPTB autograft, Seon *et al.* discovered that a delay of more than 6 months between the injury and reconstruction was a strong independent predictor of future OA. The condition of the knee at the time of reconstruction and the patient's willingness to endure surgery and recovery are likely to be individual factors that affect each patient's recovery at different times. The patients in the two groups were equivalent in terms of age, gender, graft type, surgical method, and rehabilitation regimen, which was one of the study's strengths. The quantity of patients hurt while playing a contact sport or the amount of pre-injury activity did not differ significantly. The length of the current study is one of its weaknesses since a long-term follow-up would have made it possible to determine whether group performed better in terms of clinical and functional result [37].

Conclusion

Anterior cruciate ligament tears in 60 patients were investigated, together with medial and lateral meniscal tears. At the time of their presentation to our hospital, they underwent arthroscopic surgery and were split into an early and a delayed group. According to our research, there is no discernible difference between the functional outcomes of the early surgery group and the delayed surgery group. Patients who received delayed surgery had greater medial meniscal tears and chondral injuries, although their functional scores eventually caught up to those of the early surgical group. In contrast, those who underwent early surgery had better stability and a quicker return to pre-injury activity levels. Finally, we would add that the patient's soft tissue condition, quadriceps strength, and strength are all factors that influence when the AACL Reconstruction should be performed. Additionally, a lengthy investigation is necessary for a more thorough evaluation.

Conflict of Interest: None.

Funding Support: Nil.

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ISSN 2515-8260 Volume 09, Issue 02, 2022

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European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 02, 2022

Original Research Article

Outcome of total knee replacement in osteoarthritis

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Abstract

Background and Objectives: To investigate and assess the functional results of complete knee replacement surgery. To determine whether or not there has been an improvement in post-operative pain relief. The knee joint's degree of stability as well as its range of motion to investigate the risks and potential problems of total knee replacement surgery. The pre-operative Knee Clinical Score will be compared to the post-operative Knee Clinical Score. The pre-operative Knee Functional Score will be compared to the post-operative Knee Functional Score. In order to evaluate the radiological results of the total knee replacement procedure. Research will be conducted to investigate the connection between the Knee Clinical Score and the Knee Functional Score.

Methods: A total of 20 patients who had total knee replacements were included in this prospective analysis. Cases were selected based on certain criteria, both for inclusion and disqualification. At each patient's scheduled follow-up appointment, the Knee Society Score was applied to assess their condition. Within the participants of our study, there were a total of 20 female patients and 10 male patients. Indications were 15 cases of OA and 1 case of RA. The duration of the follow-up period was typically twenty weeks.

Results: In the course of our research, prior to surgery, every one of our patients experienced moderate to severe pain; but, following surgery, 16 of the patients only experienced mild discomfort. Following surgery, the patient's average flexion, which was 75 degrees preoperatively, increased to 94 degrees. Before surgery, each of the 15 knees received a knee score of less than 60, but after surgery, some of the knees received an exceptional score (80 to 100), while the other knees received a good score (72-79). Prior to surgery, 10 patients had a functional score that was below 60, and two patients had a functional score that was between 60 and 69. Postoperatively, 20 patients had a score that was considered to be outstanding (85-100), 10 patients had a score that was considered to be good (72-79), 6 patients had a score that was considered to be acceptable (61-69), and 2 patients had a score that was considered to be poor (60).

Conclusion: The surgical method known as total knee arthroplasty is now widely practiced and well-established. The functional outcome of the surgery is impressive, long-lasting, and gratifying, and patient acceptability is very high.

Keywords: Knee replacement, knee score, osteoarthritis, knee, arthroplasty

Introduction

Embryologically, the knee joint develops from the leg bud at 28 days, and the femur, tibia, and fibula form by 37 days. Within 45 days of the creation of the patella, cruciate ligaments, and menisci, the knee joint develops from blastemal cells. The knee joint is the body's biggest and most intricate joint. A gliding joint connects the patella to the patellar surface of the femur, and two condylar joints connect the medial and lateral condyles of the femur to the corresponding condyles of the tibia. Keep in mind that the joint does not directly involve the fibula. The rounded femoral condyles are located above, the tibial condyles and cartilaginous menisci are located below, and the patella and lower end of the femur are articulated in front. Hyaline cartilage covers the articular surfaces of the femur, tibia, and patella [1-5].

Total knee replacement as we know it now dates back around three and a half decades. Since the 19th century, there has been interest in modifying the articular surfaces to improve knee joint function. Verneuil proposed the use of soft tissues in 1860 to replace the articular surface of a joint. Following that, a variety of materials including pig bladder, nylon, fascia lata, prepatellar bursa, and cellophane were utilised for this purpose, but the results were unsatisfactory. Ferguson completely resected the knee joint in 1860, creating new subchondral surfaces that made the knee joint mobile. Campbell reported the effective interposition of a metallic femoral mould in 1940, encouraged by the relative success of hip cup arthroplasty, but later outcomes were found to be dismal. Parallel to the idea of interposition arthroplasty and later surface replacement, a second line of development in knee arthroplasty took place [6-10].

The complex knee joint is prone to rheumatoid-like arthropathies, post-traumatic arthritis, and age-related degeneration, all of which can lead to significant impairment and negatively impact both general health and quality of life in relation to health. Total knee arthroplasty is the most effective treatment for the aforementioned disease. 40% of people over 50 have knee arthritis, and 80% of them require arthroplasty due to discomfort, instability, and limited range of motion. Rheumatoid arthritis affects about 7 million people in India; its prevalence is 0.75 percent. The incidence of knee arthritis caused by age-related deterioration and post-traumatic arthritis has increased along with the average life expectancy (69.25 years) and the frequency of traffic accidents, as has the number of patients receiving TKR [11-16].

Better designed prostheses with nearly normal function are the outcome of the interaction between biomechanical studies and clinical experience. The knee arthroplasty has come to be recognised as the best method for treating incapacitating arthritis. Total knee arthroplasty aims to stabilise the knee joint, relieve pain, and increase range of motion [17-22].

Aims and Objectives

To investigate and assess the functional results of complete knee replacement surgery. To evaluate the degree to which post-operative pain is relieved, the degree to which the joint's stability and mobility are improved, and the degree to which any abnormalities have been corrected. To investigate the risks and potential problems of total knee replacement surgery.

Study duration

Cases that meet the inclusion criteria and are admitted to a medical college or hospital between June 2020 to May 2022 and fall within the scope of the study will be included.

Materials and Methods

We conducted a prospective study on the functional outcome of twenty knees that had total

knee replacement surgery using a cemented posterior stabilising design at a medical college and hospital between the years 2020 and 2022.The study focused on the knees' ability to function normally after the procedure. The size of the sample, which is determined to be twenty, was determined based on previous studies as well as an estimate of the number of cases that were available during the time period in question that satisfied the inclusion and exclusion criteria [23-26].

Inclusion criteria

a) Subjects who have grade 3 and grade 4 (Kellgren Lawrence grading system) osteoarthritis of the knee with severe intractable pain and are undergoing unilateral total knee replacement
b) Subjects who have grade 3 and grade 4 (Kellgren Lawrence grading system) osteoarthritis of the knee
c) Subjects who have grade Patients that are willing to provide their consent before undergoing surgery
d) In patients with fully developed skeletons

Exclusion criteria

a) Patients who have septic arthritis of the knee joint;
b) Patients who have skin lesions local to the area
c) Comorbid disease status like:
1. Peripheral vascular disease
2. Malignancy
3. Diabetes that is not under control, severe COPD, severe cardiovascular illness, nephropathies, etc.
a) Joint pain caused by neuropathy.
b) Disorders of the neuromuscular system and joints that are paralysed.
c) Osteoporosis in its most severe form g). Bone shortage and deformities of a severe nature.

A conventional midline approach was taken with the knee bent at the point of flexion. After that, an even deeper anteromedial dissection was performed in preparation for the arthrotomy. For the purposes of soft tissue balancing and the correction of abnormalities, a medial, lateral, and posterior soft tissue release that was either limited or extensive was performed. Osteophytes in both the tibia and the femur were removed. When performing the femoral section, the appropriate femoral rotation was used, and the white slide line or epic ondylarline was used as a reference point. The extramedullary method of cutting was utilised when sectioning the tibia. We have made the ultimate sacrifice by crucifixing both of our knees. Autologous posterior condylar grafts with screws were used to address the tibial deficiencies that were present.

In both extension and flexion, the alignment as well as the balance of the soft tissues was evaluated. The trial components were put together to ensure a good fit, and then examined for tension in the soft tissue, as well as for balance in flexion and extension. The patellar tracking appeared normal in all of the patients. For the purpose of cementing the components together, one package of antibiotic-impregnated bone cement was utilized. After the tourniquet was removed, the bleeding was stopped by cauterising the wound. The wound was stitched up in stages. After surgery, antibiotic treatment was continued for a total of 2 days. The standard postoperative regimen was followed in order to grow the quadriceps, which helped increase range of motion and allowed for early weight bearing ambulation. At the end of two weeks, the sutures will be removed. Immediate clinical radiological evaluation following the

operation, as well as follow-up evaluation at regular intervals, was performed. The KSS grading method was utilised for the final review that took place. Every incident was captured on camera for record-keeping purposes. The follow-up period was for a total of two weeks, three months, and six months [27-32].

Statistical analysis

To carry out the statistical analysis, the user will make use of version 20 of the SPSS programme, which stands for the Statistical Package for the Social Sciences. The data was entered into the spreadsheet created in excel. Calculated descriptive statistics of the explanatory and outcome variables included the mean, standard deviation, frequency, and proportions for quantitative variables, respectively, while these measures were used for qualitative variables. Comparing the quantitative variables at the pre-op and post-op time periods required the application of inferential statistics such as the Paired t test. The level of relevance will be at a level 5 from now on [33-38].

Clinical Photographs

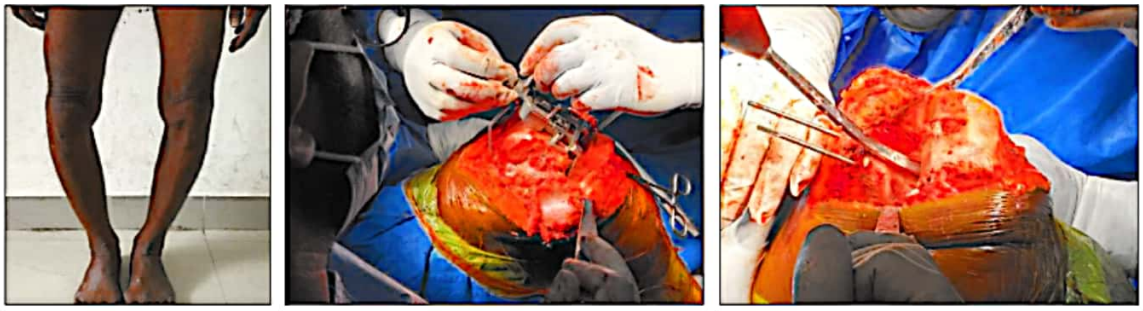

Fig 1: Anterior Femoral cut and knee replacement

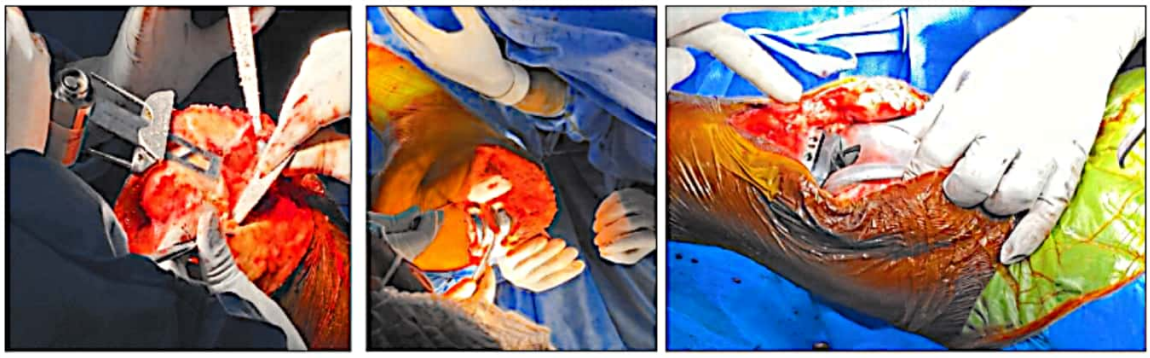

Fig 2: Knee Replacement

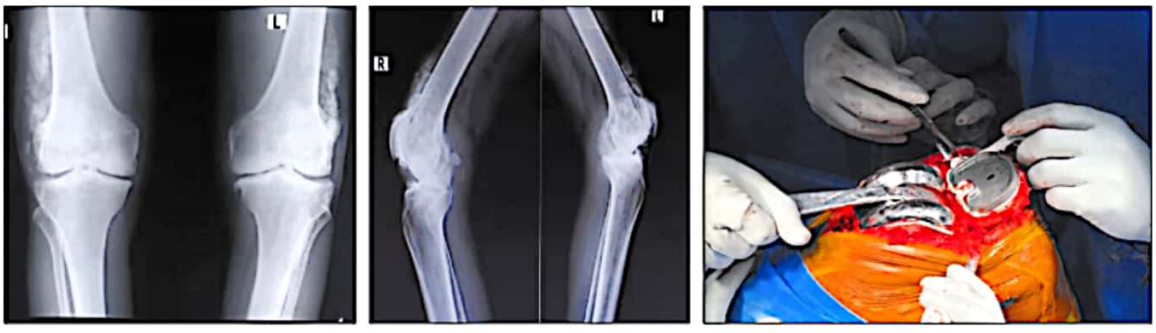

Fig 3: Pre-operative Radiographs

Follow up

Fig 4: Post-operative Photograph

Results

Table 1: Showing distribution of the subjects based on age groups

Age groups	Frequency	Percent
44 to 50 yrs.	5	25.00
55 to 60 yrs.	5	25.00
61 to 65 yrs.	6	30.00
> 65 yrs.	4	20.00
Total	20	100.00

Table 2: Showing distribution of the subjects based on gender

Gender	Frequency	Percent
Females	15	80.00
Males	5	20.00
Total	20	100.00

Table 3: Showing distribution of the subjects based on associated conditions

Associated conditions	Frequency	Percent
DM	3	15.0
HTN	3	15.0
HTN, Obesity	2	10.0
NIL	7	35.0
Obesity	5	25.0
Total	20	100.0

Table 4: Showing distribution of the subjects based on in dictations

Indications	Frequency	Percent
OA	19	95.0
RA	1	5.0
Total	20	100.0

ISSN 2515-8260 Volume 09, Issue 02, 2022

Discussion

In our study titled "functional outcome following primary total knee arthroplasty," we examined twenty patients who had total knee replacement surgery at a medical college or hospital between June 2020 and May 2022. The patients' surgeries took place between the months of June 2020 and May 2022. The majority of the indications that we found in our research were related to osteoarthritis (19 knees) and rheumatoid arthritis (1 knee). 20 patients underwent unilateral Total Knee Replacement surgery, with 11 patients undergoing surgery on their right knees (55%) and 9 patients undergoing surgery on their left knees (45%). Patients older than 40 years old were included in our study; there were 4 cases in the age group 44-50 years, 6 instances in the age range 55-60 years, 7 cases in the age range 61-65 years, and 3 cases more than 65 years old. According to our findings, the average age is 59.85 years. There were a total of 18 female patients (90%) and only 2 male patients (10%). We had 7 patients who did not have any related disorders, 3 patients who were diagnosed with hypertension, 5 patients who were obese, 2 patients who were obese and also diagnosed with hypertension, and 3 patients who were diagnosed with diabetes. Before surgery, 18 knees were in excruciating agony, while only 2 knees had moderate pain. After surgery, however, only 2 knees experienced no pain, while the remaining 18 knees had only slight discomfort. The similarities between our findings and those of other studies were striking. The pre-operative average range of movement was 69.65 degrees of flexion, and the post-operative average range of movement was 90.55 degrees of flexion, with a P value of 0.035, which indicates that there is a significant difference between the two ranges of movement. According to the findings of earlier research, Kelly G. Vince et al. reported a preoperative mean range of motion (ROM) of 88 degrees (range: 45-122 degrees), and they found a postoperative ROM of 91.2 degrees (range 52- 125 degrees). 36 of the knees exhibited A-P instability preoperatively ranging from 5mm to 10mm, however after surgery, 18 of the knees showed no A-P instability, and the remaining 2 knees had A-P instability ranging from 5mm to 10mm. 2 knees had M-L instability measuring between 10 and 14 millimetres, 9 knees had M-L instability measuring between 6 and 9 millimetres, and 9 knees did not have M-L instability. Preoperatively, 6 knees exhibited M-L instability of 6-9mm, but postoperatively, 13 knees did not have any M-L instability, resulting in a P value of 0.056, which is statistically significant.

Preoperatively, we had 2 knees with FFD of > 20 degrees, 1 knee with FFD of 16-20 degrees, 2 knees with FFD of 11-15 degrees, and 7 knees with FFD of 5-10 degrees. After surgery, 16 knees did not have FFD, and 4 knees had FFD of 5- 10 degrees, which was a significant difference with a P value of 0.006. Before surgery, one knee had an extension lag of 10–20 degrees, while the other nine knees had an extension lag of less than 10 degrees. After surgery, all ten knees had an extension lag of less than 10 degrees. Post-operatively, we had all 20 knees with normal valgus of 5-10 degree, with a significant P value of 0.00. Douglas had one knee with 15 degrees of varus, four knees with varus of 14 degrees, three knees with degree of 13 varus, six knees with 12 degrees of varus, two knees with 11 degrees of varus, and one knee with more than 20 degrees of valgus. Before surgery, we had one knee with more than 20 degrees of valgu. We had one patient who was unable to leave their home, 12 patients who were able to walk less than five blocks, and seven patients who were able to travel between five and ten blocks prior to surgery. Following surgery, 19 patients were able to walk more than 10 blocks, while only one patient could walk between 5 and 10 blocks, yielding a significant P value of 0.000. Both the preoperative and postoperative cores for the stairs were 12.75, while the postoperative core was 30. Five patients had normal up and down with rails after surgery, while the remaining fifteen patients had up and down with rails. The 0.000 P value indicates that the finding is significant.

Postoperatively, eight patients are using canes while one patient is using a walker, whereas

before surgery, twelve patients were using canes and three patients were using walkers. At the time of the preoperative examination, each of the 20 knees had a score of less than 60. Subsequently, 11 of the knees had an outstanding score (ranging from 80 to 100), whereas 7 of the knees had a good score (ranging from 70 to 79). This resulted in a P value of 0.000, indicating a significant improvement in the knee score. The preoperative mean score of 31.45 increased to 79.50 postoperatively with a P value of 0.000, demonstrating a considerable improvement in the knees core following total knee replacement. According to the findings of our research, the average post-operative knee score for patients younger than 60 years old was 79.8, whereas the average post-operative knee score for patients older than 60 years old was 79.2. When we analysed the outcomes of both groups, we found that there was no statistically significant difference between them. The postoperative functional score for patients younger than 60 years old was 69, while the postoperative score for patients older than 60 years old was 69.5. In the course of our research, none of the patients experienced any difficulties.

Conclusion

Knee replacement surgery, particularly total knee replacement, has become an effective treatment for a wide variety of knee conditions. In other words, it has its own learning curve, despite the fact that precision instrumentation seems to have simplified the surgery. The replacement surgeon needs to comprehend the complexities of the procedure in order to repeat the same results as that of experienced surgeons. One must keep in mind at all times that TKA is the beginning of the problem for a surgeon and not the conclusion of the problem. It is necessary for him to have a complete understanding of all of the complications that are linked with the procedure, including his readiness for revision arthroplasty. The true difficulty of the operation is in addressing the knee issues that young people commonly have. Despite the limitations of the technique and technology used in our study of evaluation of functional outcome following primary total knee arthroplasty, the results of the series demonstrate that total knee replacement is reliable, provides pain relief, increases range of motion, and provides good function. In spite of the fact that we have 85–90% good to exceptional early findings, our long term survivorship results still need to be monitored.

Conflict of interest: None.

Funding support: Nil.

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Medical Mycology Case Reports 46 (2024) 100670

Contents lists available at ScienceDirect

Medical Mycology Case Reports

journal homepage: www.elsevier.com/locate/mmcr

Osteoarticular mucormycosis of the distal femur in a post COVID-19 patient

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ARTICLE INFO

Handling Editor: Dr Adilia Warris

Keywords:
Osteoarticular mucormycosis
COVID-Associated mucormycosis
Disseminated mucormycosis

ABSTRACT

A 38 year old man with no known comorbidities presented with pain and swelling over the knee joint a few days after recovery from severe COVID-19. Initial debridement and cultures revealed growth of Mucorales affecting a large segment of the distal femur with also positive cultures obtained from the maxillary sinus and the lower lobe of the right lung. Due to this involvement of a long segment of the femur, right lung and left maxillary sinus, a multidisciplinary approach of above knee amputation along with debridement of left maxillary sinus and lobectomy of right lung lower lobe was performed to decrease the fungal load and favour good prognosis. This report warrants the need for early imaging and surgical debridement of tissue for fungal cultures and biopsy in immunocompromised individuals.

1. Introduction

Mucorales which primarily inhabit soil and decomposing matter are rarely associated with human infections, and are seen mostly in immunocompromised leading to poor prognosis and mortality due to its angio-invasive nature [1]. Most cases of fungal osteomyelitis reported in the literature are caused by *Aspergillus* [2] and *Candida* species [3]. Possible routes to acquire fungal osteomyelitis include direct inoculation through open traumatic injuries contaminated with soil, or as an extension from a contiguous site of soft tissue infection or through iatrogenic contamination [4]. Osteomyelitis caused by Mucorales is rare. To date, all reported cases of mucormycosis causing osteomyelitis of long bones were due to direct inoculation or iatrogenic contamination5. Hematogenous dissemination of Mucorales is reported in severe immunocompromised patients [5]. COVID-19 associated mucormycosis has been observed as a severe complication of COVID-19 during the pandemic. Cases of rhino orbital mucormycosis with intracranial extension following COVID- 19 have been widely reported [6]. There are no cases of osteoarticular mucormycosis post COVID-19 reported in literature. We report the first case of an osteoarticular mucromycosis of the distal femur in a 38 year old man who recently recovered from a severe course of COVID–19.

2. Case report

A 38 year old man without any known comorbidities, was treated for severe COVID-19 during the pandemic with intravenous steroids (Methylprednisolone 2mg/Kg body weight, twice a day for ten days) and supplementary oxygen for ten days. Two weeks after symptomatic recovery, he developed pain and swelling in the medial aspect of right knee that gradually increased and was treated with intravenous antibiotics assuming a localized abscess by a physician. He was then referred to us, as there was no improvement. At presentation (day 0) his white blood cell counts and inflammatory markers (ESR, CRP) were normal. An MRI was performed which showed signs of osteomyelitis of the right distal femur [Fig. 1]. Knee joint arthrotomy and debridement was done by lateral approach (day 1). Intra-operatively, synovium was noted to be inflamed and hypertrophied and was sent for biopsy. Periosteum of the distal femur was noted to be peeling off easily like an orange peel and the distal femur was softened, dry, powdery and discoloured [Fig. 2]. All the tissues obtained, including synovium and bone, were sent for bacterial and mycobacterial cultures, gram staining, fungal staining, histopathology and fungal culture. Patient continued to have serous discharge through the wound site.

On day 5, the synovium tissue showed no growth of any organism

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https://doi.org/10.1016/j.mmcr.2024.100670
Received 10 January 2024; Received in revised form 25 August 2024; Accepted 10 September 2024
Available online 16 September 2024

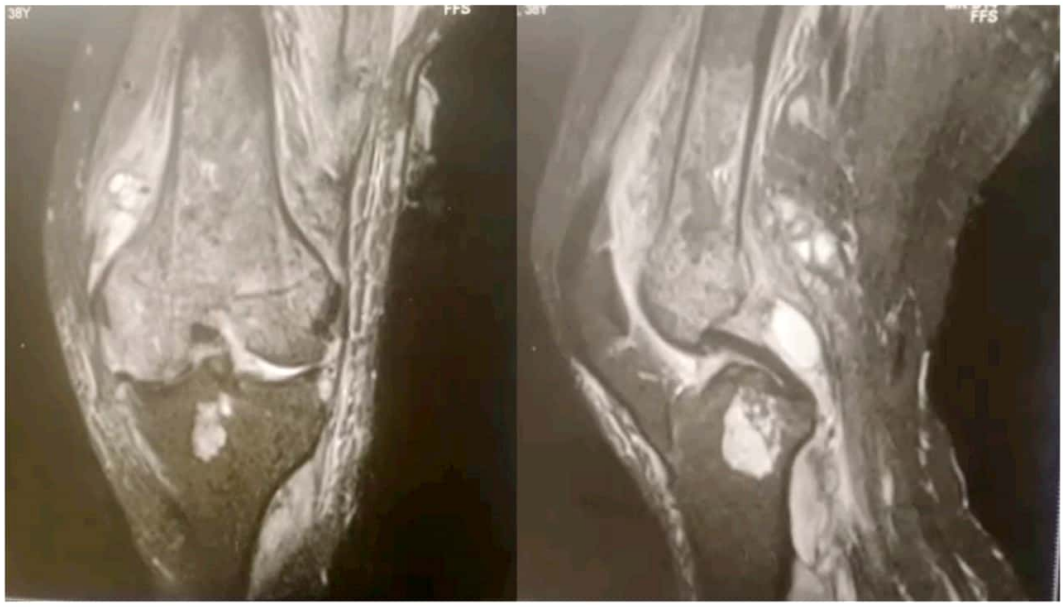

Fig. 1. PD Fat Sat sequence of MRI knee showing intracavitory lesion involving the distal third of femur with surrounding bone oedema, periosteal reaction and surrounding significant soft tissue oedema.

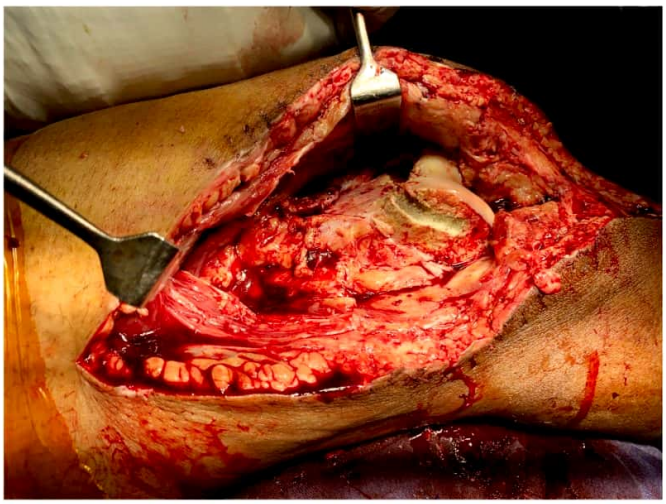

Fig. 2. Intra operative image at time of debridement showing peeling of periosteum along with discoloured bone which was dry, powdery and softened.

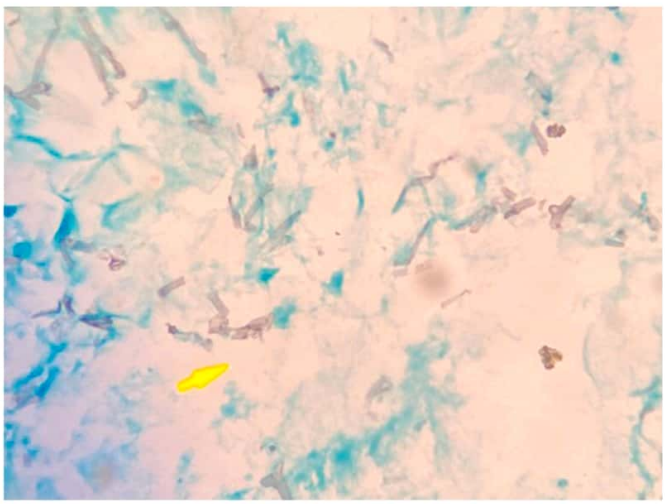

Fig. 3. Grocott Methenamine Silver staining (GMS stain) of the distal femur specimen showing scattered broad aseptate, wide angle branching fungal hyphal forms along with few narrow septate, branching hyphal forms.

upon culture, but showed inflamed and ulcerated synovial lining with fibrinous exudate and neutrophils and the underlying fibrovascular stroma showed dense chronic inflammation with scattered neutrophils on histopathological examination. The distal femur sample showed necrotic bone fragments along with stromal dense chronic inflammation and numerous foreign body giant cells. Grocott Methenamine Silver staining (GMS stain) highlighted scattered broad aseptate, wide angle branching fungal hyphal forms along with few narrow septate, branching hyphal forms [Fig. 3]. The bony specimen examined on KOH mount showed mucorales like fungi and the culture bottle was filled with white fluffy growth in 18 hours [Fig. 4]. Fludeoxyglucose F18 Positron Emission Tomography scan (FDG PET CT) was performed on day 7, and it showed hypermetabolic cortical irregularity involving the distal femur with surrounding hypermetabolic soft tissue component and heterogenous fluid collection along with hypermetabolic cavitary lesion in the lower lobe of the right lung and left maxillary sinus [Fig. 5]. CT brain showed left maxillary sinus infiltration without intracranial spread [Fig. 6A]. Considering disseminated mucormycosis involving a long segment of the femur, the right lung and the left maxillary sinus, a multidisciplinary approach was planned to control the infection (day 7). Above knee amputation and left maxillary sinus debridement [Fig. 6B] and lobectomy of right lung lower lobe [Fig. 7] was performed to decrease the fungal load and favour good prognosis (day 8). This was combined with medical management by Liposomal amphotericin B (10mg/Kg/day for 4 weeks), started on day 8 with regular monitoring of his renal function, followed by maintenance dose of posaconazole (300mg once a day for six months). The specimen of the bivalved femur showed complete destruction of the femoral condyles extending up to the meta-diaphysis junction [Fig. 8]. Lactophenol Cotton Blue staining of the distal femur specimen showed Mucorales like aseptate hyphae and sporangia with rhizoids [Fig. 9].

Patient was ambulatory with the help of prosthesis and he was followed up to 3 years after discharge and he did not develop any further complications including recurrence of infection and resumed his professional work.

Fig. 4. The culture bottle showing white frothy growth in 18 hours.

3. Discussion

Osteoarticular Mucormycosis is a devastating condition seldom seen in traumatic open injuries and post operative scenarios. Hematogenous spread of this disease is very rarely seen affecting the long bones. While Mucormycosis is highly aggressive and destructive in lungs, sinuses and brain, it is more indolent in bone thereby delaying the diagnosis. Taj-Aldeen SJ et al. in their systematic review of osteoarticular Mucormycosis noted a mean time of 73 days to diagnose Mucor fungal osteomyelitis [5]. The paucity of fever in such cases would add to delay in presentation of the patient. Costa-Paz et al. have reported a total of 21 cases of osteoarticular Mucormycosis following ACL reconstruction surgeries [7]. In their series they found that none of the patients had comorbid conditions and all the cases were a result of post operative inoculation. Direct inoculation of the organism in open injuries is commonly reported earlier. Cases of cutaneous Mucormycosis also had direct inoculation as a result of trauma and responded well to local debridement and antifungal agents [8]. Invasive aspergillosis and candidiasis represent the leading cause of invasive mold infections, whereas invasive Mucormycosis is less common [9]. Mucormycosis related osteoarticular infections as a result of hematogenous spread are reported in immunocompromised patients such as post bone marrow transplant [10], Sickle cell disease [11], uncontrolled Diabetes. However, so far there have been no reports of Mucormycosis affecting osteoarticular region or bone in a patient who has recovered from a COVID-19 infection.

A combination of factors including various medications such as high dose steroids, preexisting or steroid induced diabetes and systemic immune alteration in COVID-19 infection itself have led to an array of many secondary infections in patients affected by COVID-19. An alarming increase in Mucormycosis of rhino-orbital region including invasion in to intracranial space has been reported in recent past [12]. Such COVID-19 patients with intracranial mucormycosis invasion had a high mortality rate [6]. In the case reported by us, the patient had no pre-existing comorbidities and he has acquired COVID-19 moderate infection for which he was treated with intravenous steroids and oxygen therapy. As he recovered well, he noticed to have pain and swelling over knee joint without any fever. The time to presentation to an orthopaedic surgeon following the symptoms in knee was around 19 days. The time to diagnosis of Mucormycosis of distal femur was 26 days. The indolent nature of fungal osteomyelitis even with aggressive Mucormycosis and spectrum of clinical features and lack of awareness of fungal affection leads to delayed diagnosis which at times could be fatal.

Mucormycosis spreads hematogenously to other organs. The most common sites of origin are sinuses (39 %), lungs (24 %), and skin (19 %) [13]. Dissemination commonly affects lung and brain, whereas liver, heart, and kidneys are rarely colonized by Mucor species [14]. Our patient showed lesions in lung and sinus as demonstrated in PET-CT. There is no consensus on treatment protocol in osteoarticular diseases affected by Mucormycosis, although treatment with first line of antifungal drugs, Liposomal Amphoterecin B and maintenance antifungals like Posoconazole along with surgical debridement is effective. Treatment is always customised basing on other systematic involvement and clinical status of the affected patient and should always be multidisciplinary by discussing with microbiologists, pathologists and infectious disease specialists, Pulmonologists and Otorhinolaryngologists. In our case, the patient had a long segment of femur affected along with foci of colonization in lungs and maxillary sinuses, which warranted for amputation to avoid mortality. Treatment protocol cannot be standardised and should be individualized on a case-by-case basis, based on pressing clinical issues with close monitoring of patients clinical condition.

All osteoarticular infections should be screened ideally for fungal elements along with bacterial and mycobacterial foci, particularly in immunocompromised including post COVID-19 patients. Establishing the diagnosis of invasive fungal infections by conventional culture based mycological methods is often difficult, especially in early stages [15]. Routine blood investigations and inflammatory markers are not effective in diagnosing the osteo-articular fungal infections. Mucorales-specific antigens are not yet accepted for diagnostic purposes because of its low sensitivity [15]. Clinical suspicion along with early radiological evaluation by MRI particularly in post COVID-19 recovered patients would be helpful for early diagnosis and recovery. Early and aggressive surgical debridement's and tissue evaluations for fungal elements should not be hesitated to establish early diagnosis of osteoarticular Mucormycosis.

This aggressive case of osteoarticular Mucormycosis with hematogenous dissemination illustrates the diagnostic challenge particularly during COVID-19 pandemic. Due to potentially devastating complications, including mortality and amputation, high index of clinical suspicion to diagnose fungal musculoskeletal infections should always be considered. Successful treatment of mucormycosis infection requires a multidisciplinary approach, especially in systemic colonization. This report justifies the need for early imaging and surgical debridement of tissue for fungal cultures and biopsy to establish the diagnosis of fungal osteomyelitis and prevent devastating complications.

CRediT authorship contribution statement

Srinivas Kasha: Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Methodology, Project administration, Investigation, Formal analysis, Data curation, Conceptualization. **Venugopal Palakurthi:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Ranjith Kumar Yalamanchili:** Writing – review & editing, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data

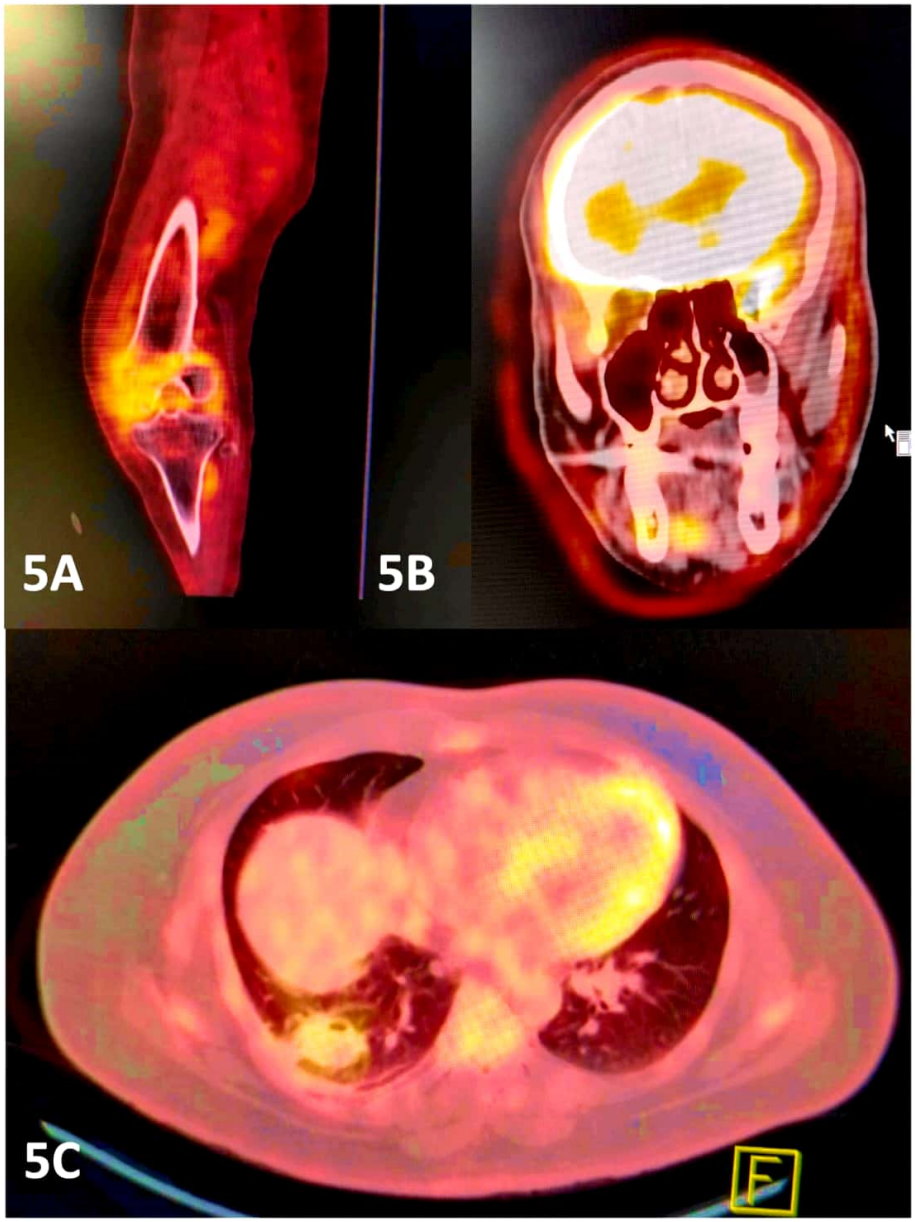

Fig. 5. Fludeoxyglucose F18 (FDG) Positron Emission Tomography scan (FDG PET CT) showing hypermetabolic activity in distal femur (4A), left maxillary sinus (4B) and lower lobe of right lung (4C).

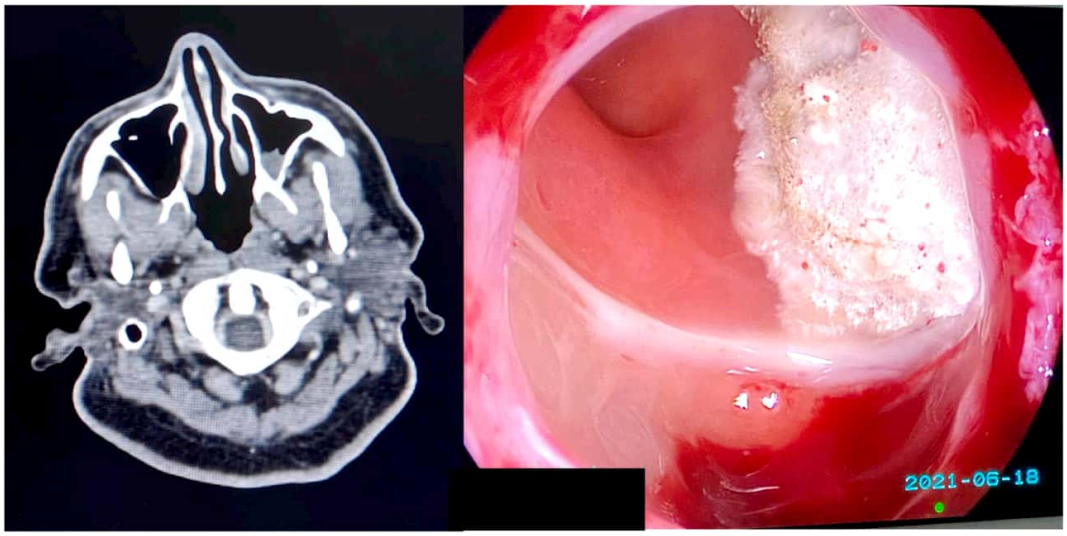

Fig. 6. Fig. 6A) CT Brain axial section showing left Maxillary sinus mucosal thickening due to mucormycosis. Fig. 6B) Nasoendoscopic picture of the same patient with a fungal ball in the left maxillary sinus.

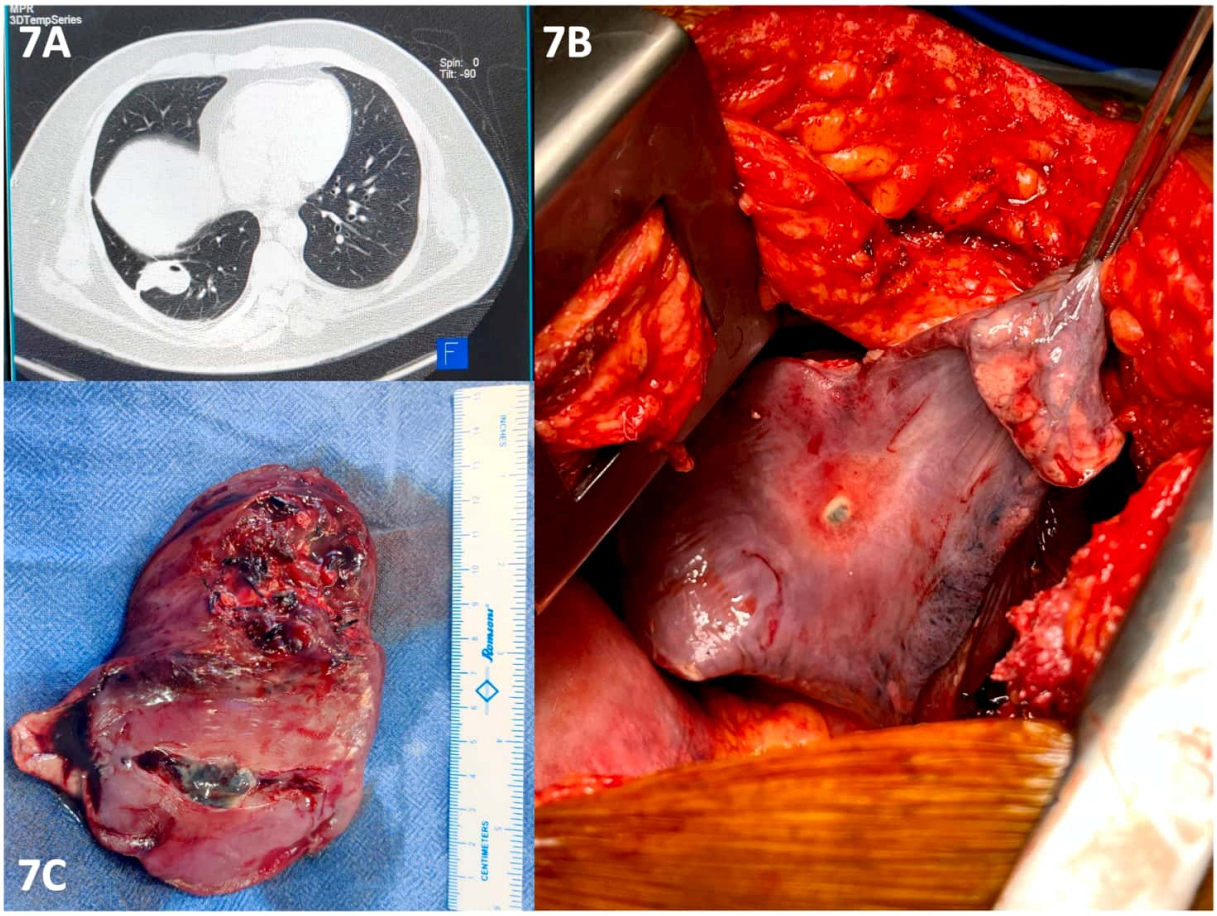

Fig. 7. Fig. 7A: CT chest showing the lesion in left lower lobe. Fig. 7B: Intra operative picture of lobectomy of the lesion. Fig. 7C) Specimen of resected right lung lower lobe affected with a Mucor cavitatory lesion.

Fig. 8. Bivalved distal femur specimen showing destruction of large segment distal femur by Mucor osteomyelitis.

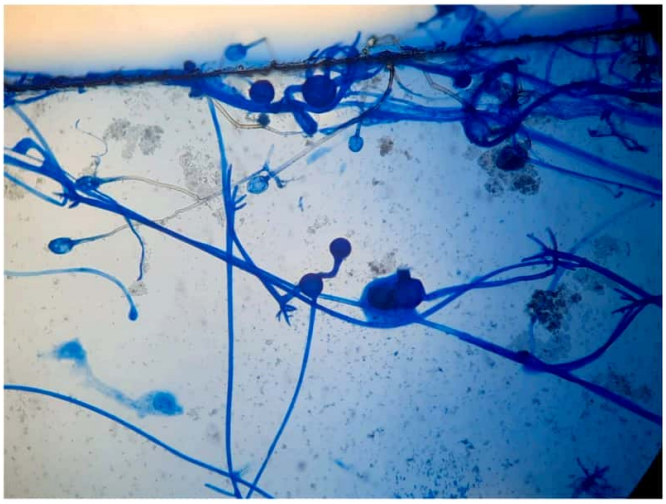

Fig. 9. Lactophenol Cotton Blue staining in a 10x view shows Mucormycosis eliciting aseptate hyphae, sporangium with rhizoids. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

curation, Conceptualization. **Patil Pratik Yashavant:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Rohith GPRK:** Writing – review & editing, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

"The authors declare that they have no competing interests".

Acknowledgement

The authors acknowledge fellow clinicians Dr Satish Rao Immaneni MD, Consultant Pathologist, Dr KV Krishna Kumar - Consultant Cardiothoracic Surgeon, Dr B Kalyan Chakravarthy - Consultant Head and Neck Surgeon, Dr Chaithanya I – Consultant Radiologist, Dr Rafath Fatima - Consultant Microbiologist working at Krishna Institute of Medical Sciences, Secunderabad, Telanagana, India who have contributed for this case as a part of multidisciplinary approach.

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