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LUPIN PHARMA

LUPIN

For The Management of Osteoporosis

For The Management of Osteoporosis

℞ CORCIUM Fit

Coral calcium, Vitamin D3, Zinc gluconate, Pine bark extract

℞ CORCIUM PLUS

Coral calcium, Folic Acid, Vitamin B6, Vitamin B12 (as Cyanocobalamin) (Cap)

℞ CORCIUM K2

Coral calcium, Calcitriol, Vitamin K2 (Tab)

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℞ Nutrajoint

℞ MOVNWAK

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INDEX

Next Orthopaedic Pandemic Awaiting

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Natural history of most of the pandemics which have occurred previously shows regression following the second wave. All these previous pandemics have occurred during the time when the medical and health facilities were not so developed and hence had profound and long lasting effects due to the pandemic itself. But in today's era of modern medical technologies, the health facilities have been developed and grown to such an extent, that the vaccine and treatment for pandemic which previously took 3 to 4 years to develop, are been developed in just 6 to 8 months time. Hence, post covid era will show sustained and long lasting effects not only due to covid disease alone, but will also show the complications and side effects of covid treatment as well.

The ideal treatment of covid-19 is yet to be deduced, but guidelines for mild, moderate and severe form have been designed by AIIMS, New Delhi and approved by ICMR and WHO. The treatment of milder forms (URTI or fever) involves just home isolation and symptomatic treatment by antipyretics and oral Ivermectin. Steroids should not be used in milder form of disease. Treatment of moderate form of covid requires hospital admission, oxygen support, anitiviral therapy with injection Remdesivir, convalescent plasma along with intravenous methyl-presdnisolone and low dose anticoagulants. Severe form of covid additionally requires ICU support and injection Tocilizumab and high end therapies like lung transplant and ECMO.

With the kind of scattered health facilities and mixed pathies present in our country, it is quite evident that there is lack of protocol and guideline based management. Multiple types of treatments ayurvedic, homoepathic, herbal, desi kadha etc are used frequently for treatment without evidence based proven effect and without even knowing what the contents are. Further due to, huge population, high ignorance and illiteracy, delayed presentation, treatment by quacks and untrained staffs, it is quite common to have improper treatment with inadvertent, unjustified, long duration of treatment with the drugs other than prescribed. Hence steroid, which should not be given in milder form, are given or advised even in mild or non-symptomatic cases, that too for longer duration's. This irrational, inadvertent and continued use of the treatment especially by use of steroid and remdisivir will cause complications and side effects associated with use of these drugs. This problem probably will be further increased by use of sub-optimal quality and sub-optimal doses of the treatment leading to poor response to treatment and further provocating longer duration of treatment, creating a vicious circle. Thus to summaries, with the quantum of covid infected patients as rampant in our country and use of treatment based on irrational protocol, yet another pandemic due to side effects and complications related to the covid treatment is going to come in near future. Early complications following the treatment like diabetes, cardiac arrest and mucormyosis are already been manifested in society.

The use of inadvertent, irrational, suboptimal and prolonged steroid therapy, along with other complications, is also associated with severe orthopaedic complications, among which the most common are osteoporosis, fragility fractures and avascular necrosis of femoral head. Hence we orthopaedic surgeons in near further will see a pandemic of these post-covid infected cases presenting to us after the treatment with steroids.

Hence we should be aware, suspicious, prepared for prompt diagnosis and judicious early treatment of these cases. We should also be aware and prepare ourselves with newer modalities of diagnosis, instruments, equipment and treatment guidelines of these complications so that these entities can be diagnosed earliest and treated successfully, without any severe complications.

Post steroid osteoporosis, skeletal fragility fractures and avascular necrosis can lead to rapid deterioration of health status, decreased quality of life, increases dependency and economic burden. Fragility fractures, particularly hip fractures are also associated with high rates of mortality, which is preventable if we could reduce them. Contrary, to the fact that these were the pathologies seen in elderly patients, after the post steroid treatment in covid patients, these pathologies will be at rise in early age groups as well, and if we are not aware, suspicious and prompt enough to diagnose them in even these younger age group, we are likely to miss them or can have delayed diagnosis when they present to us with complications.

Screening for osteoporosis and avascular necrosis in these high risk patients of post covid with steroid treatment will help us to diagnose and treat osteoporosis and avascular necrosis, at early stage and minimize the risk of fractures and joint destruction, respectively, associated with these entities. This will involve orthopaedician to do early assessment by complete medical examination with thorough clinical history, look for clinical risk factors, and order for basic laboratory investigations and biomedical markers of bone turnover along with measurement of bone mineral density (BMD) with Dual-energy X-ray absorptiometry (DEXA) scan or high quality digital x rays. Further patients with positive medical history, suggestive clinical suspicions and or presence of additional risk factors should undergo further additional targeted laboratory testing and investigations which will provide useful information to risk stratify patients.

Specific additional risk factors which should warn the orthopaedician are, advancing age, history of prior fracture, low body weight, cigarette smoking, excessive alcohol consumption, estrogen deficiency, vitamin D or calcium malabsorption, systemic inflammation, autoimmune disorders and/or high bone turnover states. Measurement of bone mineral density most commonly, precisely and accurately can be done by Dual-energy X-ray absorptiometry (DEXA) or quantitative ultrasound.

Evaluation of biochemical markers can predict low bone mass and bone loss, estimate future fracture risk and monitor the treatment. Biochemical markers, which can be used, are the marker of bone formation which are alkaline phosphatase, osteocalcin and Procollagen I Extension Peptides, and markers for bone resorption which are hydroxyproline, Pyridinium Cross-links and Telopeptides and Tartrate-Resistant Acid Phosphatase.

In addition to measurement of bone quantity, high-resolution peripheral quantitative computer tomography (HR-pQCT) and magnetic resonance imaging technology can help to measure bone strength and determine qualities of bone such as its geometry, macro, micro, and nanostructure, material composition, volumetric bone density, cortical and trabecular micro-architecture. These non-invasive methods can also help to diagnose avascular necrosis of femoral head early before the signs occur which are evident on x rays.

Surgeon should also be familiar with fracture risk assessment tools like FRAX algorithm, which provides estimates of an individual’s 10-year probability of hip fracture or major osteoporotic fractures which incorporates 11 patient factors (i.e., age, sex, height, weight, prior fracture, parental hip fracture, smoking, alcohol, glucocorticoids, rheumatoid arthritis, and either secondary osteoporosis or BMD) to calculate an individual’s fracture risk.

Once the diagnosis has been made, we should treat the osteoporosis and avascular necrosis earliest by use of proper nonpharmalogical, medical and surgical therapy, to prevent complications associated with it. Non-pharmacological treatment of these, include life modification to prevent falls and subsequent fragility fractures. This includes correction of refractory errors, use of walking aids, installation of bars, railing and support specially in bathrooms and stairs, using non skid floors, and use of antifracture devices. Light exercises and taking a healthy diet rich in calcium supplements, vitamin D and high proteins along with avoiding risk factors, smoking and alcohol will keep the bone healthy.

Medical therapy of osteroporosis and avasular necrosis includes prescribing anti-resorptive therapy in form of biphosphonates, hormone replacement therapy, calcitoin, selective estrogen receptor modulators like raloxifene. Surgeon should also know about dosage, prescription, interaction and contraindication of the recent and evolving therapies like Denusumab and biologics like growth hormone, Teriperatide and Parathyroid hormone etc.

Surgical treatment of these patients can be a challenge, owing to their younger age, poor bone quality and lack of ideal fixation method in porotic bones and delayed mobilization. We should be prepared for surgical treatment, if needed at earliest, as early surgery can reduce, hospital stay, mortality and complications. Surgical treatment of osteoporosis involves vertebroplasty, kyphoplasty or prophylactic fixation in certain cases specially hip before the fracture occurs. Further, when bone quality is impaired, surgeon should be prepared for augmented synthesis with use of bone grafts auto as well as allografts, cements, bone substitutes like tricalcium phosphate and biologic and growth factors like BMPs along with armamentarium of specific implants like locking plates, TSP plates, helical blades fixations, multi directional nails and longer implants than normally used etc. Surgical treatment for avascular necrosis in early stages by core decompression and pedicle grafting can prevent the joint replacement surgery.

To summarize, we the orthopaedic surgeons should be prepared, aware and cautious enough, to deal with the forthcoming pandemic, which is just about to come after the end of second wave of the covid. This orthopaedic pandemic will be especially in the form of large number of cases presenting to us with osteoporosis, fragility fractures and avascular necrosis of hip, which will be due to complications associated with the steroid treatment of covid patients. If we can diagnosis and treat the patients early before the occurrence of fragility fractures or the need for joint replacement, we could successfully say that we orthopaedic surgeons have dealt with this pandemic successfully.

"It is better to prevent and prepare rather than rent and repair"

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Non-traumatic Osteonecrosis of the femoral head: an overview

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Abstract

Osteonecrosis of femoral head is a debilitating condition that frequently affects the young. Risk factors primarily include corticosteroid use, alcohol consumption, trauma, blood dyscrasias and coagulation abnormalities. Despite multiple theories, no single mechanism has been successful in fully explaining the pathophysiology, except for one common factor that impairment of circulation to the femoral head leading to subsequent development of necrotic patches. The natural history of the disease is eventual collapse of the hip joint and arthritis; therefore, early diagnosis and intervention are essential. Size and location of the lesion are prognostic factors of progression of the disease process and are best evaluated on magnetic resonance imaging. Management of non-traumatic osteonecrosis remains evolving with better knowledge of the disease process and advances in treatment options. In an early stage, joint-preservation is the primary objective, which offers options of core decompression alone or with adjunctive vascularized bone grafts, avascular grafts, bone morphogenetic proteins, stem cells, or combinations of the above or by transtrochanteric osteotomies. Once collapse has set in, total hip replacement has been the preferred treatment of choice. Nevertheless, careful patient selection and understanding the etiology plays a pivotal role in deciding course of management and choice of implants.

Keywords: Non-traumatic, Osteonecrosis, Avascular necrosis, Femoral head, Total hip arthroplasty

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Introduction

Osteonecrosis of the femoral head (OFH) with poorly understood etiology, is a debilitating condition that frequently affects young patients in 3rd to 5th decade of life [1]. Despite low incidence and prevalence compared with primary osteoarthritis, OFH has a significant economic impact because it largely affects the younger population. As the femoral head collapses, there is pain and loss of function. The natural history of the disease is progression to hip dysplasia, femoro-acetabular impingement to eventually total collapse of the hip joint and arthritis. When left untreated, it tends to lead to severe secondary joint destruction in the majority of patients [2]. Therefore, awareness of risk factors, early diagnosis and intervention are essential which can prevent complications.

Etiology and Pathogenesis Though the etiology of OFH is not yet absolutely clear, it is understood that a multi-factorial process is involved [3].

Long-term corticosteroid treatment is the most frequent risk factor of OFH, seen in 10 to 30% of cases [4]. Treatment for two to three months with a daily dose of 2 g prednisolone equivalent or more is regarded as critical. The patho-physiology of steroid-associated OFH is controversial, but proposed mechanisms include abnormalities of the lipid metabolism and bone marrow stem cell pool, hyperlipidemia, distribution of fat emboli in circulation, hypercoagulable state, vascular endothelial dysfunction and apoptosis of bone tissues [4]. All these multiple factors influence each other, resulting in marrow ischaemia and eventually osteonecrosis.

Excessive alcohol consumption has also contributed to the incidence of non-traumatic OFH. Matsuo K et al showed that an intake of up to 320 g ethanol (equivalent to 5 bottles of wine) per week raised the risk of non-traumatic OFH by approximately a factor of 2.8 [5]. Alcohol has a significant effect in terms of increase in serum triglyceride/cholesterol levels, deposition of triglycerides in osteocytes leading to pyknosis, increased percentage of empty osteocyte lacunae, subchondral fat cell hypertrophy and proliferation and bone marrow fatty infiltration. Similar to corticosteroids, alcohol tends to increase adipogenesis at the cost of osteoblastic proliferation or function and hence leading to decreased osteogenesis, but through a different mechanism than steroid as alcohol-treated stromal cells did not show increase in PPAR-γ expression which was noted in steroid affected cells [6]. Although the mechanisms may differ between these two, the consequences of adipogenesis, hypercoagulability and diminished reparative capability all contribute to the final pathway of cell death.

Smoking has also been found as a risk factor, although no dose-effect relationship has been established. Heavy smokers (>20 cigarettes / day) demonstrated higher risks of OFH than light smokers (<20 cigarettes/day), who in turn showed higher risk when compared with nonsmokers [5,7].

OFH can be caused by hypercoagulability and thrombotic occlusion of the micro-circulation occurring from hereditary thrombophilia, impaired fibrinolysis, antiphospholipid antibodies or sickle cell disease and other hemoglobinopathies [8,9]. Additional causes include environmental or acquired / preexisting conditions, such as hyperlipidemia, hypersensitivity reactions, thromboplastin release during pregnancy, malignant tumors, and inflammatory bowel disease, all may contribute additional risk to individuals with an underlying genetic predisposition to form microvascular thrombi. Björkman A et al and Zalavras et al showed that mutations in the factor V Leiden or prothrombin 20210A gene and protein C and S deficiencies were significantly more common in patients with idiopathic OFH than in patients with steroid or alcohol-induced OFH, as well as in a population of healthy control subjects [10,11].

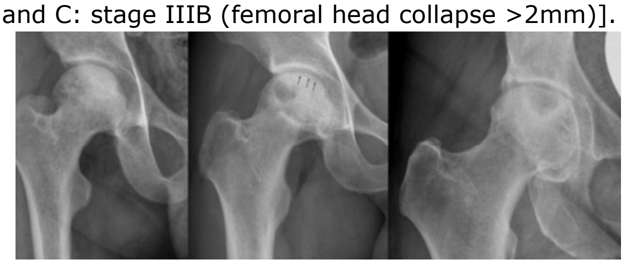
OFH has also been observed more frequently in HIV patients, with or without antiretroviral treatment. It is not known whether the association is due to protease inhibitors alone or whether there is a multi-factorial link in combination with other risk factors such as the HIV infection itself, a history of systemic corticosteroid use, or hyperlipidemia [12].

History, Clinical features and Diagnosis

The role of careful history is vital in screening for potential risk and/or prognostic factors, to determine if other joints are involved, to look for other conditions that might present with similar symptoms, and to chalk out management. The onset of disease is insidious and the symptoms and signs are usually minimal and nonspecific until the disease reaches an advanced stage. Therefore, a high index of suspicion and ordering early imaging may contribute to an early diagnosis, as diagnosis of OFH is primarily based upon imaging findings.`

Radio graphs are the most easily accessible, ready available, simple, low cost screening tool for diagnosis of OFH, which is seen as sclerosis surrounding an osteopenia area, cystic changes and crescent shaped lucent lesion in early stage and loss of sphericity, subchondral collapse and degenerative arthritis involving arthritic changes on the acetabular side as well in advanced stage (Figure 1).

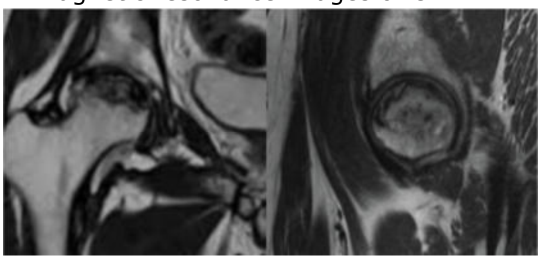
Fig 1. Radiographic images of different ARCO stages [A: stage II, B: stage IIIA (crescent sign) and C: stage IIIB (femoral head collapse >2mm)].



This is best visualized on the frog leg lateral view as it depicts the profile of the most common location for a subchondral fracture, i.e., the superior lateral portion of the femoral head's anterior segment. The disadvantage of radiographs is its insensitivity for detecting OFH in its early stages [13].

Magnetic resonance imaging (MRI) is useful screening tool for early diagnosis, quantitative evaluation of disease extent within the femoral head and staging of the disease and hence is the imaging method of choice with the highest sensitivity and specificity compared to plain radiographs, computed tomography, or scintigraphy [14] (Figure 2). A single-density thin "band-like" lesion with low signal intensity rim surrounding the necrosis on T1-weighted images and a "double-line" sign consisting of a low signal intensity outer rim and a high signal intensity inner rim on T2-weighted image are considered diagnostic of the disease [15,16].

Fig 2. Magnetic resonance images of OFH.



Computerized tomography (CT) While radiographs and MRI are useful, CT delineates the outline of the subchondral bone / necrotic zone / fracture most clearly in three dimensionally. CT also detects small areas of collapse which are not seen on plain radiographs or MRI [17]. In spite of these advantages, due to ionizing nature and since prognosis and decision making requires MRI, CT scan are not primarily advised.

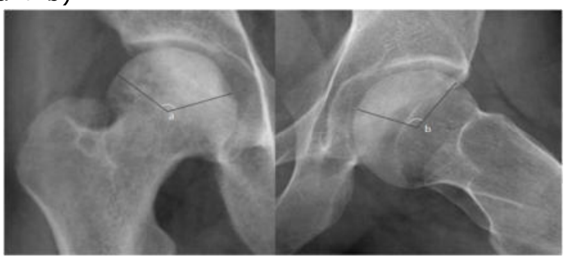
Technetium-99 isotope scan: Necrotic region of bone does not take up the radioactive isotope ("cold" on scan), whereas the surrounding rim of reactive bone remodeling takes up the isotope ("hot" on scan), hence in the early stage of disease, bone scan showing "cold within hot" area. After subchondral fracture, attempts of repair are seen as "hot lesion" that obscures the original cold area. Bone scan is limited by poor spatial resolution, low specificity to differentiate other disorders, and inability to quantify the lesion [16]. For these reasons, nuclear studies are inferior screening tools in the management of OFH.

Prognosis

Detecting prognostic factors (subchondral fracture, extent and location of the lesion) and understanding the treatment options based on the stage is essential part of the management.

Prognosis on radiological evaluation primarily depends on: (1) presence or absence of head collapse, (2) amount of head collapse, (3) size and site of the necrotic lesion, and (4) acetabular involvement. A change of more than 2 mm in the femoral head contour confers a worse prognosis. The combined necrotic angle of Kerboul measured on radiograph or MRI gives substantial detail on the size of the necrotic lesion, and are highly reliable and reproducible [15] (Figure 4). Regarding, location of the necrotic lesion, small medially located lesions may be treated by observation alone whereas acetabular involvement directs towards hip replacement and saving the femoral head is bound to fail [18,19].

Fig 3. Measuring combined kerboul's angle on AP and lateral radiographs (Combined angle of Kerboul = a + b)



There have been sixteen major classification systems to stage OFH and provide guidance on prognosis, decision making and outcome. The Ficat classification [20] (Table 1) is the most frequently used system (63%), followed by the University of Pennsylvania system (20%) [21] (Table 2), the Association Research Circulation Osseous (ARCO) system (12%) [22] and the Japanese Orthopaedic Association system (5%) [23]. The Association Research Circulation Osseous (ARCO) classification system was developed for clinical trials, by merging the Ficat, Steinberg, and Japanese Orthopaedic Association systems. Recently in 2019, the ARCO classification was revised (Table 3) to provide uniform platform for clinical and research applications [24].

Table 1. Ficat and Arlet Classification [20]

Stage		Description
I		Normal radiographs
II		Sclerotic or cystic lesions
	IIA	No sign of subchondral collapse
	IIB	Subchondral collapse (crescent sign on radiograph) without femoral head flattening
III		Femoral head flattening
IV		Osteoarthritis with decreased joint space, articular collapse, or acetabular involvement

Table 2. University of Pennsylvania Classification (Steinberg) [21].

Stage		Description
0		Normal findings on radiographs and MRI
I		Normal findings on radiographs and abnormal MRI findings
	IA	<15% of head affected
	IB	15% to 30% of head affected
	IC	>30% of head affected
II		Sclerotic changes on radiographs
	IIA	<15% of head affected
	IIB	15% to 30% of head affected
	IIC	>30% of head affected
III		Subchondral collapse and/or fracture
	IIIA	<15% of head affected
	IIIB	15% to 30% of head affected
	IIIC	>30% of head affected
IV		Femoral head flattening
	IVA	<15% of head affected and <2 mm of head depression
	IVB	15% to 30% of head affected or 2 to 4 mm of head depression
	IVC	>30% of head affected
V		Joint space narrowing with or without acetabular involvement
VI		Advanced degenerative changes

Table 3. The 2019 Revised ARCO Classification System for Osteonecrosis of the Femoral Head [24]

Stage		Description
I		Normal radiograph; MRI shows band lesion (low intensity) around the necrotic area.
II		Radiographic evidence of sclerosis, focal osteoporosis or cystic changes; no evidence of subchondral fracture or fracture in the necrotic portion.
III		Subchondral fracture, fracture in the necrotic portion, and/or flattening of the femoral head on radiograph or CT scan.
	IIIA	Femoral head depression of ≤2 mm
	IIIB	Femoral head depression of >2 mm
IV		Radiographic evidence of osteoarthritis, joint space narrowing, and degenerative acetabular changes.

Treatment

Optimal treatment of OFH has been a subject of discussion and research for a long period of time, though no conclusive path has been framed till date. Treatment can broadly be divided into nonoperative and operative methods. The main aim of treatment is preservation of hip anatomy by preventing bone destruction and collapse of the femoral head. Non-operative treatment of pharmacological agents, physical therapy like hyperbaric oxygen and shock wave therapy, along with supportive treatment to offload the hip, have been tried with limited evidence of applicability [25,26].

Non-operative Treatment

Restricted weight-bearing to offload the affected hip have been suggested in patients awaiting surgery. Systematic review analysing the natural history of untreated asymptomatic OFH stated that 59% of such hips had disease progression at a mean of 7 years, with risk of collapse highest among sickle cell disease and least among systemic lupus eythematosus. Large lesions (involving>50%) had 84% chances of progression, while it was 32% in small- or medium-sized lesions [27].

Pharmacological agents

Various pharmacological agents used in preventing disease progression and preservation of unaffected areas are effective in the initial stages of the disease only. There is a paucity of multi-centre studies and research regarding comparison of various pharmacological agents and their benefit over surgical methods.

Bisphosphonates They acts by preventing osteoclastic resorption of the bone tissue, but their role in OFH have been a matter of debate with evidence, both promoting and discouraging, its use. Agrawala et al and Lai et al, found that alendronate significantly prevents the chances of collapse, preserves joint function and delays the chances of replacement surgeries when started in initial stages of the disease, but its benefit in later stages is limited [28,29]. In contrast to these studies mentioned above, there are multiple studies stating that bisphosphonates have only a limited role, if any in preventing progression of the disease [30-32].

Lipid Lowering Agents (Statins) Statins by preventing adipogenesis can play an important role in preventing osteonecrotic collapse in steroid-induced OFH, but it may not be efficient in reversing the changes or induce healing in such cases [4,33]. Ajmal et al in 2881 renal transplant patients showed that on 15 (4.4%) patients out on 338 on statins and 180 of 2,543 (7%) patients who were not on statins, developed OFH [34].

Vasodilators Prostacyclin analogs like ilioprost has shown to lower intraosseous hypertension and increase blood flow to the ischemic area, seen as significant improvement in pain and functional scores as shown by Jager et al in 95 patients of OFH receiving ilioprost [35].

Anticoagulants Vitamin K inhibitors, low-molecular weight heparins and direct thrombin inhibitors have been used to prevent progression of OFH in patients without collapse due to coagulation disorders. Enoxaparin administered at a dose of 6000 IU or 60 mg daily or Warfarin given in 1-5 mg/kg/day dose for 12 weeks is found to be effective in preventing development of OFH or progression of disease [36].

Biophysical Methods

Various biophysical methods have been suggested for treatment in OFH.

Pulsed electromagnetic field therapy (PEFT) functions by stimulating osteogenesis and angiogenesis, but, its role in early-stage OFH treatment remains to be established [37].

Extra-corporeal shock wave therapy (ESWT) restores tissue oxygenation, reduces edema and induces angiogenesis and hence it offers a feasible and good substitute to invasive surgical modalities [38].

Hyperbaric oxygen (HBO) increases reactive oxygen and nitrogen species in tissues, induces modulation of endothelial progenitor cell proliferation, promotes neo-angiogenesis and neo-vascularization, increases extracellular oxygen concentration and reduces bone marrow pressure and improves oxygen delivery to ischemic cells, relieving compartment syndrome and preventing necrosis [39,40]. Moghamis et al showed no statistical significance between groups treated by hyperbaric oxygen and core decompression in terms of functional and radiological outcome, but hyperbaric oxygen was suggested as an effective noninvasive alternative to core decompression [41].

Non-operative modalities have generally been ineffective in halting the disease progression and are inappropriate options to prevent collapse. Majority of studies on non-operative treatment modalities are from single-centre, are of low evidence and have inconclusive results, these options are only suggested auxiliary to operative treatment [42].

Operative treatment

The choice of surgery depends upon the extent of involvement, and stage and location of the disease. Operative options are procedures that preserve the native hip joint and total hip replacement. Joint-preserving procedures, which aim to prevent or limit the disease progress are core decompression and its variants (i.e. adjunctive grafting, stem cell therapy), bone grafting and proximal femoral osteotomies. These procedures are preferably used in symptomatic young patients without femoral head collapse (precollapse) or in select patients with minimal collapse.

Core decompression is a surgical procedure wherein a core is drilled in the lesion to decompress the raised intraosseous pressure cause by cellular swelling and inflammatory cell infiltration, and facilitate a channel for new blood vessels [43]. Favorable outcomes of core decompression, in symptomatic precollapse small lesions to early collapse stages are seen when performed either using a single wide-bore trephine (10mm) or multiple small-diameter (3-8mm) drilling.

Studies have demonstrated an overall success rate of core decompression to 65% at an average follow-up of 54.3 months along with failure rate of 14 to 25% in small lesions and that of 42 to 84% in larger lesions [44]. Song WS et al demonstrated 78% survivorship at five-year follow-up and 88% of small- to medium-sized lesions did not require surgery at a mean follow-up period of 7.2 years. He found standard core decompression and multiple drilling both equally effective with no difference in the odds of improvement [45]. Arthroscopy-assisted core decompression provides added advantages of articular cartilage visualization, evaluation of degree of collapse, guide the reamer and avoid the risk of joint penetration [46].

Core Decompression with adjunctive therapy Incorporating cell-based components like bone marrow stem cells, platelet-rich plasma or tantalum rods into the tract created by drilling is performed adjuvant to core decompression with varying success rates.

Bone marrow aspirate concentrate augmentation of core decompression in comparison to core decompression alone, improves hip function, decreases stage progression, delays the collapse of femoral head and decreases the THA conversion rate better, especially in pre-collapse disease, but not in advanced lesions [47,48].

To sum-up, results of cell-based therapies with core decompression are promising. However, the lack of standardization of harvesting, processing and transplant methods, lack of knowledge on amount of cells needed for definitive success, and doubtful potency of mesenchymal stem cells of patients with osteonecrosis are setbacks to their incorporation into regular practice.

Non-vascularized bone grafting is used in symptomatic precollapse and early postcollapse lesions when the overlying articular cartilage is relatively undamaged, as bone grafting provides structural support and scaffold for bone remodelling, in addition to reduction in intraosseous hypertension, and removal of necrotic bone. Three approaches for placing bone graft are described (1) Phemister technique - cortical graft is placed through a core tract in the femoral neck and head; (2) trapdoor technique - graft is placed through a trapdoor created through the articular cartilage of the femoral head; and (3) light-bulb technique - graft is placed through a window created in the femoral neck at the base of the head [18]. Non-vascularized fibula can be placed as a cortical strut graft, either single or double in the tract drilled following core decompression. Wu CT et al reported 88.5% and 76.9% of 5-year and 12-year survival rate after double-fibular allograft strut grafts in hips with collapse <2mm respectively [49]. Studies suggest that bone grafting procedures are reserved for small to medium sized lesions in young adults only [50].

Vascularized bone grafting provides added benefit of restoration of vascular supply to the necrotic lesion and is primarily advocated in precollapse lesions. Free vascularized fibular graft and vascularized iliac crest bone graft are most commonly practiced vascularised bone grafting types. Ünal MB et al reported post-operative HHS>80 in 15 of 16 hips of grade II disease and in 6 of 7 hips of grade III in mean follow up of 7.6 years after vascularized fibular graft [51]. Vascularized grafts are limited by setbacks of dedicated team, availability of operating microscope, technical difficulty, long-operating hours, concerns over patency of anastamosis, and potential harvest-site morbidity.

Muscle-pedicled bone grafts utilize locally available bone while maintaining its vascular pedicle, in turn acting as vascularized bone graft. Various such grafts like Meyer's quadratus femoris muscle-pedicle bone graft, Baksi's sartorius-pedicle or tensor fascia lata muscle-pedicle iliac bone grafts, and other's lateral femoral circumflex vessel pedicled iliac graft and gluteus medius-pedicle greater trochanter flaps have been performed successfully with reduction in stage progression and conversion to arthroplasty, equally as shown by Zhang L et al and Zhao D et al [52,53].

Femoral osteotomy The goal of proximal femoral osteotomies is to shift the necrosed segment away from the weight-bearing region. Success rates of femoral osteotomies vary from 70 to 93%, with two types of osteotomies (1) angular intertrochanteric (2) transtrochanteric rotational osteotomies. Since, rotational osteotomies allow a greater degree of translation of the necrotic area, it shows better outcome in terms of preventing stage progression, preventing collapse and conversion to THR, compared to intertrochanteric curved varus osteotomy, but rotational osteotomies are difficult to perform and are associated with higher risk of non-union [18]. These procedures can produce good results in the earlier stages of necrosis but when collapse has set in, these osteotomies bound to fail. Femoral osteotomies have varied acceptance owing to limitations in patient selection, indications of osteotomies regarding lesions, difficulty in performing the procedure, uncertain outcome, prolonged immobilisation, and difficulty in subsequent conversion into THA [54].

Head sacrificing procedures

Joint-preserving procedures are inadequate and hip arthroplasty is indicated in large precollapse and postcollapse lesions, advanced stage when the femoral head has collapsed >2mm, arthritic changes at the hip joint or for salvage, when other modalities have failed. Head sacrificing procedures include: (1) hemiresurfacing (2) hemiarthroplasty (3) total hip arthroplasty (cemented or cementless).

Hemiresurfacing was introduced as time-buying procedure after failure of joint-preserving surgeries, as THA was an unfavourable in the young patient and they preserved bone stock and had lower dislocation rates. Amstutz HC et al demonstrated survivorship of 80%, 63% and 36% at 5, 10 and 13 years after hemiresurfacing respectively [55]. Due to complications of resurfacing like metal-on-metal interface complications, decreased survivorship, and increased risk of periprosthetic fractures, these procedures are seldom done these days [25].

Hemiarthroplasty can be considered when the acetabular cartilage does not show any arthritic changes. Chan et al showed no significant differences in rate of additional procedures at mean of 6.4 years after hemiarthroplasty or THA [56]. Femoral loosening, acetabular protrusion, osteolysis, polyethylene wear and high failure rates in long term lead to fallout of hemiarthroplasty as a treatment option in OFH.

Total hip arthroplasty Cemented and cementless total hip arthroplasty (THA) have been extensively used and analysed for OFH.

Cemented THA done for OFH have shown survivorship of 99% and 64% at 10 and 20 year follow-ups respectively. Early studies attributed, failure of interdigitation of cement to defective cancellous bone in patients with osteonecrosis, as the cause of aseptic loosening in cemented THA [111]. Improvements in implant surfaces, highly cross-linked polyethylene and improved sterilization and storage of polyethylene have led to lower wear rates and increased survivorship of >90%.

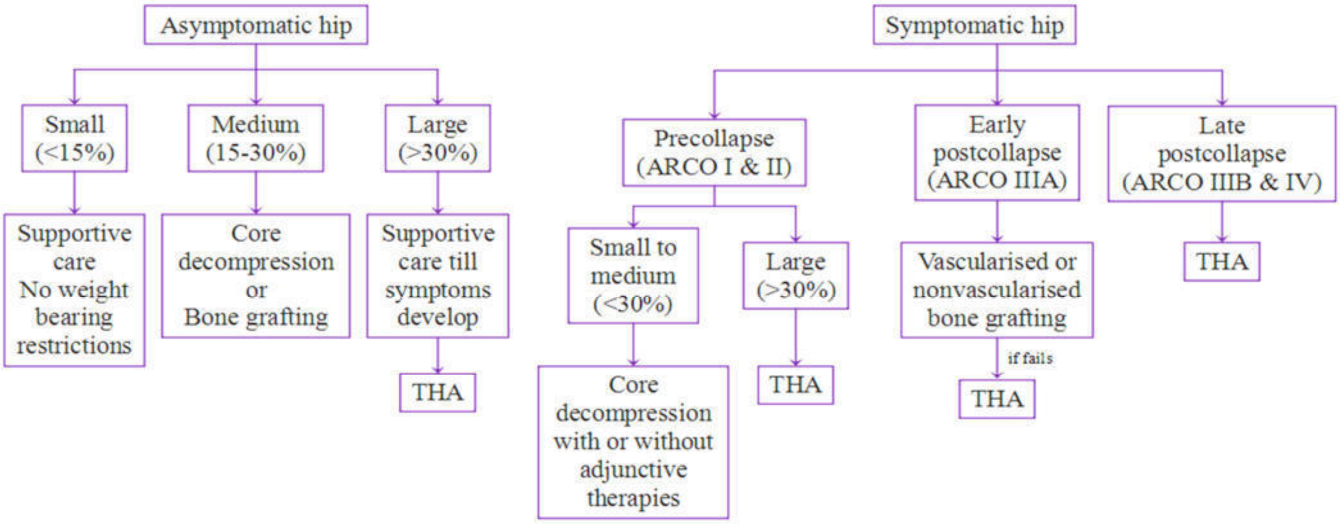
Cementless THA have survivorship of 94% in at an average follow-up of 16 years. Kim YH et al reported 99% survivorship of the femoral component and 99.4% of the acetabular component, after a mean follow-up of 14.7 years, after ultra-short proximal loading uncemented femoral component for Ficat and Arlet stage III or IV osteonecrosis [57]. Selection of the femoral prosthesis should be according to the overall quality of bone and age of patient. As patients of non-traumatic OFH are usually of the younger age group, short-stem with diaphyseal anchorage components are preferred to preserve the metaphyseal bone stock and prevent aseptic loosening. Recent studies, have demonstrated excellent long-term clinical outcomes after THA with median HHS of 93 points and 15 year revision rate was 6.6%. Owing to improvements in prosthesis design and surgical techniques, the outcomes of THA have drastically improved.

Approach to management

The choice of treatment plan for OFH depend on multiple comprehensive factors including manifestations of blood supply changes in the necrotic femoral head, staging and classification of OFH, necrosis volume, joint function, age and occupation of the patient, and his/her compliance to rehabilitation following joint-preservation procedures.

Following comprehensive analysis on classification, prognosis and clinical outcomes, Mont MA et al staged OFH according to collapse; precollapse, early precollapse (head depression ≤2 mm), and late collapse (depression >2 mm or acetabular changes) [25]. Depending on this stage of collapse and the size of lesion, the authors suggest the algorithm for guiding the treatment (Figure 4).

Fig 4. Treatment algorithm for non-traumatic osteonecrosis of the femoral head (Adapted from Mont MA et al [25])



Conclusion

Osteonecrosis of the femoral head is a progressive disease which can be a major source of disability for young patients. It requires a proper understanding of the underlying disease being dealt with. Being a progressive condition, it needs to be tackled at the foremost instance. MRI is both a sensitive and specific screening tool to identify the disease at its earliest stages. Recent evidence states that nonoperative modalities are neither effective in halting the progression of the disease nor in preventing collapse. In precollapse and early stages, the primary objective is preservation of the native joint. Core decompression, vascularized or non-vascularized bone grafting, and femoral osteotomies have been described. Biological augmentation of core decompression has shown to have promising results in early stages of the disease. Patients with lesions more than 2 mm femoral head collapse or acetabular changes require total hip arthroplasty.

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Functional outcome of distal end femur fractures treated by minimally invasive plate osteo-synthesis using locking compression plate: a prospective study in 50 adults

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Abstract

Background: Distal femoral locking compression plate can be done via a minimally invasive method, overcoming the drawbacks of excessive periosteal stripping as caused by the open method. The fixed locking construct of the plate also provides stable fixation needed for early mobilization in fractures of the distal femur. Hence, we evaluated the results of the distal femoral locking compression plate done via minimally invasive technique in fractures of the distal end femur.

Material and methods: 50 cases of fracture distal end femur were treated by internal fixation with distal femoral locking compression plate via minimally invasive techniques and were evaluated radiologically for union and functionally using NEER'S Score.

Results: 50 distal end femoral fractures (29 males and 21 females) with a mean age of 51 years (range 20 to 83 years) were included in the study. The mean duration for surgery was 67 minutes (range 60 to 89 minutes), mean blood loss was 119 ml (range 100 to 140 ml) and mean union time was 14.3 weeks (range 11 to 20 weeks). 38 (76 %) patients had excellent results and 8 (16%) had satisfactory results as per NEER's scoring system with a mean NEER's score of 90.133 (range 74 to 96). Complications were knee stiffness as seen in 4 (8%) cases, 4(8%) had a superficial infection, 1 (2%) had implant failure, 2 (4%) had mal-alignment and 1(2%) had nonunion.

Conclusion: Pre-contoured distal femoral locking compression plate by virtue of its features provide stable fixation and done via minimally invasive technique, provides excellent function, high rate of bone union, and fewer complications, even in severely comminuted fractures and osteoporotic bones of distal end femur.

Keywords: Distal end femur fracture, Locking compression plate, Neer's scoring system, Minimal invasive technique

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Introduction

Distal end femur fractures account for about 4% to 7% of all femoral fractures with a bimodal age distribution. Accurate anatomic articular reduction, restoration of limb alignment, stabilization and early mobilization are the key steps in the management of distal end femoral fractures. Open reduction and stabilization with plate allow achieving these key steps. Traditional plate fixation techniques (blade plate, dynamic condylar screw-plate, non-locking condylar buttress plate) as done by open methods, leads to over compression of the plate to the femoral shaft, causing excessive additional damage to the periosteum, along with damage caused by opening the fracture site [1].

Locking compression plate (LCP) creates toggle free, fixed angle, singly beam construct where the power of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness. It also offers high pullout resistance contrary to unlocked plates, especially advantageous for fixation in osteoporotic bone. It's this exclusive biomechanical property which is based on splinting rather than compression, results in flexible stabilization and avoidance of stress shielding. Further, it can be applied via minimally invasive techniques, which allows for prompt healing, lower rates of infection & reduced bone resorption as the blood supply is preserved [2,3]. A distal femoral locking compression plate (DFLCP) offers multiple points of fixed-angle contact between the plate and screws in the distal end of the femur even with a small epiphyseal segment, reducing the tendency for varus collapse, which can be a complication with traditional lateral plates [3]. We evaluated the outcome of the distal femur locking compression plate done by minimally invasive plate osteo-synthesis in distal femoral fractures.

Material and methods

This study was conducted in 50 cases of closed fracture of distal end femur treated by minimal invasive DFLCP at our centre, after obtaining ethical committee approval and written informed consent from all the patients. All cases of closed distal end femur fracture in more than 18 years age patients operated within a week of injury were included in the study. Open fractures, associated neurovascular injury, pathological fractures, and any other ipsilateral injury to the same limb were excluded from the study.

After haemo-dynamic stabilization of the patient and fitness for surgery, all patients were planned for surgical fixation by distal femur locking compression plating via minimally invasive method. All patients were operated under spinal anaesthesia in the supine position without a tourniquet on a radiolucent operating table via a lateral approach. Plate fixation was done by minimally invasive methods after achieving anatomical reduction by indirect methods using small bolsters/bumps placed underneath the distal thigh to correct sagittal plane deformities. Reduction clamps and traction were used to correct alignment in the coronal plane and to maintain leg length respectively. Once accurate reduction was obtained and checked under the C-Arm in both the views, an appropriate sized anatomically pre-contoured distal femur locking compression plate was slided in the sub-muscular plane holding one end of the plate with a sleeve and was aligned to the contour of the bone. Following this, the proximal and distal segment was fixed provisionally with the help of K-wires and then the length of the plate, alignment and reduction was rechecked under the C-Arm, and the plate was readjusted for centring the plate on the shaft (fig 1). For distal fixation, at least 5 metaphyseal locking screws without violating intercondylar notch were used. Proximal fixation was done under fluoroscopic guidance with at least four bicortical locking screws with multiple stab incisions just over the proximal holes in the plate with help of the sleeve. A combination of conventional and locking screws were used, conventional screws were inserted before locking screws to bring the plate and fragment nearer.

Postoperatively, the limb was kept elevated with the knee in 10º to 15º of flexion. Active hip & knee mobilization and static quadriceps exercises were allowed from postoperative day one. Suture removal was done at 2 weeks. Patients were mobilized on crutches/walkers with toe-touch weight-bearing at 6 weeks. Full weight-bearing was initiated depending on the radiological evidence of bony union and was not permitted until the consolidation of the fracture site was seen. Patients were followed regularly at 4 weekly intervals up to 6 months, then every 3 months up to one year, and 6 monthly thereafter. Patients were assessed functionally using NEER's score and progress of healing was assessed with routine antero-posterior and lateral radiographs.

Result

50 distal end femoral fractures were treated in our study via minimally invasive technique by distal femoral locking compression plate. 29 cases were males and 21 were females. The mean age was 51 years (range 20 to 83 years). 38 cases sustained trauma due to road traffic accident, 11 due to fall from height and 1 sustained injury due to industrial accident. 34 cases had a fracture of the right side and 16 on the left side. 40 (80%) cases had A3, 5 (10%) had A2, 3 (6%) had A1 and 2 (4%) had B1 type of fracture as per AO classification. 4 (8%) cases had associated diabetes mellitus, 10 (20%) had hypertension and 1 (2%) had mitral stenosis.

The mean duration for surgery was 67 minutes (range 60 to 89 minutes) and the mean blood loss was 119 ml (range 100 to 140 ml). 38 (76%) patients had excellent results and 8 (16%) had satisfactory results as per NEER's scoring system with a mean NEER's score of 90.133 (range 74 to 96) at a mean follow-up of 1 year. Only 4 (8%) patients had poor or unsatisfactory results. Mean union time was 14.3 weeks (range 11 to 20 weeks) (fig 2). There were 10 (20%) patients who had a radiological union between 11-12 weeks, 15 (30%) patients had a union between 13-14 weeks, 20 (40%) patients had a union between 15-16 weeks, 3 (6%) patients had a union between 17-18 weeks and 2 (4%) patients had a union between 19-20 weeks. Complications were knee stiffness as seen in 4 (8%) cases, 4 (8%) had a superficial infection, 1 (2%) had implant failure, 2 (4%) had mal-alignment and 1 (2%) had non-union.

Fig 1. Intra-operative photograph (a,b) & fluoroscopic view (c) of a patient of distal end femur fracture showing patient position & minimal invasive approach (a), sliding of the plate (b) and fixation with DFLCP (c).

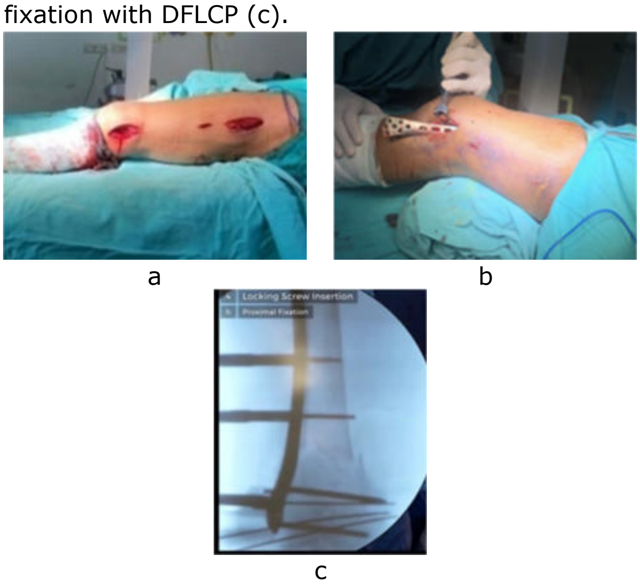

Fig 2. Pre-operative (a,b), immediate postoperative (c,d), and 6 months follow up (e,f) antero-posterior and lateral X-ray of 30 years male with fracture distal end femur treated with DFLCP showing sound union at 6 months and clinical photograph (g,h) at 6 moths showing a good range of motion at the knee.

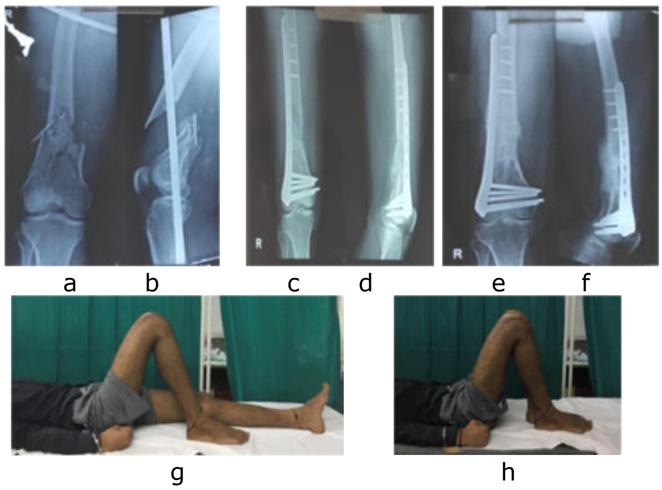

Table 1- Comparison of our results with other studies

S.No	Study	Year	Scoring	Excellent	Satisfactory	Unsatisfactory	Poor
1.	Saini et al [5]	2018	Neer	62%	32%	6%	-
2.	Girisha et al [12]	2017	Neer	24%	71%	5%	-
3.	Krishna et al [16]	2015	Neer	50%	36.6%	10%	3.3%
4.	Raoll et al [17]	2015	Neer	32%	48%	16%	4%
5.	Raghu et al [18]	2017	Neer	50%	35%	15%	-
6.	Sah et al [19]	2017	Neer	66.6	23.8	4.7	4.7
7.	Khajotia et al [20]	2019	Neer	48.8%	35.5%	11.1%	.04%
8.	Medhi et al [21]	2019	Neer	78.48%	-	16.45%	5.06%
9.	Srinath et al [22]	2019	Neer	65%	15%	20%	-
10.	Rajpal et al [23]	2019	Neer	54%	28%	22%	-
11.	Our study	2020	Neer	76%	16%	8%	-

Discussion

Various modalities used for the treatment of distal end femoral fracture ranges from conventional plates, dynamic condylar screw to intramedullary nailing. All these various treatment modalities have problems like loss of reduction, excessive soft tissue stripping and violation of joint, joint stiffness, non-union, malunion, implant failure, mal-alignment or infections etc, due to the fact that these require excessive stripping to achieve accurate anatomical reduction and prolonged immobilization due to compromised stability [1,4]. Mast in 1989 first emphasized the importance of reduced surgical dissection at the fracture site, with the aim to maintain the blood supply to the fracture ends and to thus reduce the rate of non-union and utilized the surrounding soft tissues for fracture reduction called as 'indirect reduction' of the fracture [5]. Krettek et al extrapolated the concept of obtaining relative stability rather than absolute stability for internal fixation with plate, as similar to intramedullary nails. They also suggested minimal interference with the zone of injury, which was achieved by sliding plates in the sub-muscular plane on the lateral side of the femur by a minimally invasive method [6]. Distal femoral locking compression plate overcomes both the drawbacks of excessive stripping as it can be done via minimally invasive methods and a fixed locking construct provide stable relative stability which can enhance early joint mobilization and thus prevents these complications, leading to good to excellent functional outcome [2-4].

We evaluated the outcome of distal femoral locking compression plating fixed via minimally invasive technique in 50 cases of distal end femoral fractures with a mean age of 51 years and found excellent to good results in 92 % cases in mean union time of 14.3 weeks. Our results were comparable to the studies of Saini et al, Yeap et al, Liu et al, Doshi et al, Khursheed et al and Girisha et al [7-12].

All of our cases united in mean 14.3 weeks without any augmentation except in one case, who was treated with additional secondary bone grafting alone, as the plate was well fixed. Kregor et al reported a series with 5% of the cases required bone grafting but it was unclear from the description what was the mean time to union and the indication for bone grafting [2].

The advantages and excellent outcome with the use of distal femoral locking compression plate via minimally invasive technique were also highlighted by Jain et al, El-Ganainy et al and Necmioglu et al [13-15]. All of these studies concluded that DFLCP via MIPPO is one of the best available options for the management of challenging fractures of distal end femur owing to the fact that it disrupts the femoral blood supply less than the traditional open methods and pre-contoured DFLCP fits the distal end of the femur, anatomically. Thus DFLCP is more advantageous, biologically than the traditional methods (table 1). A pre-contoured DFLCP plate provides rigid fixation in the wide distal femur with thin cortices and poor bone stock which is difficult to achieve with a conventional non-locking plate. Table 1 shows the comparative results of different series with our study.

The complications with the procedures are lesser in comparison to a traditional plate. We encountered knee stiffness, superficial infection, implant failure, mal-alignment and nonunion as complications in our study, but all these complications were within acceptable limits and comparable to known series [7-15]. Our study is limited by lack of comparative group and inherent bias due to the inclusion of all types of distal end femoral fractures in the series.

Conclusion

Pre-contoured DFLCP plate by virtue of its features provides stable fixation. It can be done via minimally invasive technique, hence is soft tissue preserving surgery which protects blood supply to fracture ends and thus provides excellent functional outcome, high rate of bone union and fewer complications, even in severely comminuted fractures and osteoporotic bones.

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Comparative Analysis of Functional Outcome of Conventional Midline Parapatellar to Minimally Invasive Subvastus Approach in Total Knee Replacement

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Abstract

Background: Minimally invasive subvastus total knee replacement (TKR) has gained popularity over the past few years. Early results of this minimal invasive TKR have shown no clear advantage over conventional longer midline parapatellar approach in relation to the functional outcome and recovery. Hence we analyzed and compared the functional outcome of conventional midline longer parapatellar approach with minimal invasive subvastus approach in TKR surgery.

Material and methods: All cases operated for TKR by two approach minimally invasive subvastus approach or conventional midline parapatellar approach were compared for length of incision, amount of blood loss (drain in first 24-hrs), tourniquet time, visual analogue pain score, range of motion, straight leg raising (SLR), length of hospital stay, knee functional & objective society scores.

Results: 40 patients with mean age 65.3 years (range 59 to 72 years) of osteoarthritis knee who underwent TKR by conventional midline parapatellar approach or minimal invasive subvastus approach were included in the study. 27 were female and 13 were male. The mean incision length, mean tourniquet time and mean total blood loss in conventional midline parapatellar approach group was 18.85 cm (range 17 to 19 cm), 65.5 min (range 60 to 70 min) and 347.6 ml (range 240 to 460 ml) respectively. The mean incision length, mean tourniquet time and mean total blood loss in minimal invasive subvastus approach group was 10.30 cm (range 9 to 11 cm), 85 min (range 80 to 90 ml) and 293.35 ml (range 175 to 409 ml). The mean length of hospital stay was same in both the groups 6.8 days (range 5 to 9).

Conclusion: TKR by conventional midline parapatellar approach demonstrated better functional outcome, reduced operative time, reduced tissue trauma (lesser pressure by retractors), shorter learning curve, easier availability of implant and instrument sets and precise implant placement due to a good visualization of the surgical field in comparison to minimal invasive subvastus approach. Hence conventional midline parapatellar approach method which is tried and time tested, still holds important corner stone in TKR surgery and should be given due consideration.

Keywords: TKR, Midline parapatellar approach, Minimally invasive subvastus approach

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Introduction

Joint replacement (arthroplasty) is a well-established definitive treatment option for end stage arthritis, which is a chronic degenerative disorder of multi-factorial aetiology and is associated by the loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis, and biochemical and morphological alterations at the synovial membrane as well as the joint capsule [1-5]. With huge population, more than 1.2 billion people in Indian had significant knee arthritis, requiring replacement. Replacement of such a large population will create enormous economic pressures on the healthcare system in terms of longer hospital stay, post-operative visits and rehabilitation [6,7].

Minimal invasive total knee replacement (TKR), done with a smaller skin incision and a smaller arthrotomy can decrease morbidity, hospital stay and promote early rehabilitation but at the cost of limited exposure and increased surgical time [8-10]. Whereas conventional midline longer surgical incision provides better visualization of the surgical field, reduced tissue trauma due to avoidance of excessive tissue compression by retractors, reduced surgical time and shorter learning curve for surgeons, but at cost of blood loss and morbidity [11-12]. There are no clear common guidelines dictating the length of incision needed for primary TKR, where some are in favour of minimal invasive TKR while others promoting conventional midline parapatellar approach. Hence, we conducted this study to compare the functional outcome of conventional midline long parapatellar approach to minimal invasive subvastus approach in total knee replacement.

Material and method

40 patients of primary osteoarthritis (OA) of knee operated for total knee replacement at our institute were included in the study. The study protocol was approved by the institutional ethical review committee and was conducted as per the good clinical practice guidelines and the principles laid down in the Declaration of Helsinki. Well written informed consent was obtained prior to the study from all the participants.

All patients with either sex and any age of primary osteoarthritis knee undergoing total knee replacement were included in the study. No exclusions based on body mass index (BMI) or pre-operative deformities were done. All enrolled patients were randomized to either surgery by conventional midline parapatellar approach TKR (n=20) or minimally invasive subvastus TKR (n=20) in a ratio of 1:1. All procedures were performed by surgeons with similar level of training and expertise. Age, sex, weight, BMI, height, preoperative deformity, range of motion, preoperative knee functional and objective score were recorded.

All patients were operated under spinal or epidural anaesthesia in supine position under tourniquet.

a. In the conventional midline parapatellar approach group – Anterior midline incision from tibial tuberosity to tendinous portion of quadriceps was made and median para-patellar approach was used. Patella was everted with knee flexion to expose knee.

b. In the minimally invasive subvastus group – Anterior midline incision from 2 cm distal to joint line from the tibial tuberosity to 2 cm above the superior pole of patella was made and sub-vastus approach was used by developing a medial sub-fascial flap by dividing the exposed vastus medialis obliquus (VMO) muscle. The patella was displaced laterally but was not everted (subluxation).

For both groups, femoral cuts were performed using intramedullary guiding system via anterior referencing technique and placing cutting jigs with femoral component in 5° valgus as referenced to the femoral intramedullary axis in the coronal plane and at 180° as referenced to the femoral intramedullary axis in the lateral plane. An extra-medullary guide was used for placement of the tibial resection guide to resect the tibia at 90° to its anatomical axis in the coronal plane, and with a 3° down slope in the lateral plane. All femoral and tibial components were fixed in place using cement after confirming the size by using trials and checking for equal flexion and extension gap. The osteophytes around the patella were nibbled and the inferior surface of patella was refreshed and patellar tracking was tested.

Post operatively a negative pressure drain was fixed for 48 hours. Deep vein thrombosis prophylaxis was given to all patients in form of low molecular weight heparin (clexane 0.4/0.6 post op after 3 hours and 6 hours after which 14 days of Xeralto (rivaroxaban) and 3 months of ecosprin 75 mg). Mobilization was started from day two with full weight bearing with a knee immobilizer for support and a walker for balance. Active and passive and assisted ROM exercises were started simultaneously. No continuous passive motion machine was used. Post-operative pain was managed by epidural spinal catheter (tramadol /buprenorphine/fentanyl) kept for 48 hours post operatively.

Postoperatively, patients in both the groups were compared for length of incision, amount of blood loss (drain in first 24-hrs), tourniquet time, visual analogue pain score, range of motion, straight leg raising (SLR), length of hospital stay, and knee functional and objective society scores. Statistical analysis was done using windows-based program SPSS (Statistical Package for the Social Sciences) version 17. The age and other measurements (blood loss, surgery duration and incision length) were compared between the two groups using independent sample t-test, whereas the scores for the HSS subscales and total scores were compared between the two groups using Mann-Whitney 'U' test (non-parametric). Discrete data for the patients in categories of HSS subscales are analyzed using chi-square test. All analyses were done using two-sided tests at alpha 0.05 (95% confidence level).

Results

40 patients of OA knee with mean age of 65.3 years (range 59 to 72 years) who underwent TKR were included in the study. 27 were female and 13 were male. 20 cases of TKR were included in conventional midline parapatellar approach group and 20 cases in minimal invasive subvastus group.

The mean incision length, mean tourniquet time and mean total blood loss in conventional midline parapatellar approach group was 18.85 cm (range 17 to 19 cm), 65.5 min (range 60 to 70 min) and 347.6 ml (range 240 to 460 ml) respectively. The mean incision length, mean tourniquet time and mean total blood loss in minimal invasive subvastus group was 10.30 cm (range 9 to 11 cm), 85 min (range 80 to 90 ml) and 293.35 ml (range 175 to 409 ml). The mean length of hospital stay was same in both the groups i.e. 6.8 days (range 5 to 9).

Active straight leg raise was achieved significantly quicker in the conventional midline parapatellar approach group as compared to the minimally invasive subvastus group due to greater confidence in the implant placement. The post-operative pain on day one was lower in minimally invasive subvastus group as compared to the conventional midline parapatellar approach group, but the amount of narcotics consumed in the first 72 hours was same in both the groups. Furthermore, on the third post-operative day the flexion was better in the conventional midline parapatellar approach group as compared to the minimally invasive subvastus group. Conventional midline parapatellar approach group patients had a better ROM at 6 months follow up also. Since range of motion was better in conventional midline parapatellar approach group, the KSS score was also higher in this conventional midline parapatellar approach group as compared to minimally invasive subvastus group ($p=0.0618$). No major complications were noted in either of the groups.

Discussion

Various surgical approaches are used for total knee arthroplasty ranging from midline parapatellar, midvastus, subvastus to quadriceps sniff etc. Among these midline parapatellar and subvastus approach are the two most commonly used surgical approaches [7-14].

First described by Von Langenbeck in 1879, conventional midline parapatellar approach is standard approach in majority of knee joint replacement, with advantage of good joint exposure but at cost of impairing the extensor mechanism of knee joint, interfering patellar vascularity, patellofemoral instability and maltracking [15]. Subvastus (quadriceps sparing) approach introduced by Hoffman in 1991, is less invasive approach, provides better postoperative knee range of movements and less impairment of patellar vascularity but it is a technically demanding [16].

The available literature shows no clear advantage of short incision (minimal invasive subvastus approach) over longer incision (conventional midline parapatellar approach), hence we decided to analyze and compare the functional outcome of long incision total knee replacement (conventional midline parapatellar approach) to short incision total knee replacement (minimal invasive subvastus approach) in 40 total knee replacement patients with mean age of 65.3 years and found that subvastus approach had shorter mean incision length and lesser mean blood loss but higher mean tourniquet time as compared to the conventional midline parapatellar approach. In our study the pain score was higher initially in the conventional midline parapatellar group, but in the follow-up period the pain score was same in both the groups. Roysam et al, Dutka et al and Bridgman et al also found similar results as ours [17-19], but Weinhardt et al, Van Hemert et al and Teng et al did not found such results [20-22]. There was no significant difference between the complications in both the groups, which was in accordance with other studies [17-22].

The mean hospital stay in both the groups was almost the same in our series but Tenget al and Bourke et al found shorter hospital stay in subvastus group due to reduced post-operative pain and early mobilization due to preservation of quadriceps musculature [22,23]. In our limited 40 patient study group, conventional midline parapatellar approach total knee replacement provided a better functional outcome as compared to a minimally invasive subvastus approach.

Minimal incision subvastus total knee replacement approach has same skin incision as of conventional parapatellar approach, but is smaller in size and it approaches the knee joint with less soft tissue dissection as joint is exposed via medial to vastus medialis muscle thus sparing quadriceps and without patellar eversion. The limited visibility as seen in subvastus approach, can lead to mal-alignment of the components and hence all these beneficial effects would be underweighted if the minimal subvastus approach resulted in implant mal-positioning. On the other hand, the conventional midline parapatellar approach used for more than 50 years provide excellent visibility required for placement of components in proper position, but at the cost of disruption of the quadriceps mechanism, eversion of the patella, dislocation of tibio-femoral joint and interruption of suprapatellar pouch. But all the complications are within the acceptable range by this conventional approach and the approach is time tested with excellent results and 10-year survival of more than 90% [24,25]. Out study is limited by lesser number of patients and lesser follow-up.

Conclusion

Our study showed that total knee replacement by conventional midline parapatellar approach showed better functional outcome, reduced operative time, reduced tissue trauma (lesser pressure by retractors), shorter learning curve, easier availability of implant and instrument sets and precise implant placement due to a good visualization of the surgical field in comparison to minimal invasive subvastus approach, hence conventional parapatellar approach method which is tried and time tested, still holds important corner stone in knee replacement surgery and should always be given due consideration.

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Comparison Of Free Hand Versus Offset Guide Technique For Femoral Tunnel Placement In Arthroscopic Anterior Cruciate Ligament Reconstruction

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Abstract

Background: Accurate femoral tunnel placement is one of the most crucial steps of ACL reconstruction, and also a predictor of better outcome. This study was done to compare two methods of femoral tunnel drilling, freehand method and offset guide method and to assess them by 3D CT Scan using Bernhard Hertel quadrant to find out which is better method of tunnel placement.

Material and methods: 30 patients, who underwent arthroscopic ACL reconstruction from June 2018 to April 2020, were compared for the femoral tunnel placement by freehand and offset methods and were assessed by postoperative 3D CT Scan. Height and length of femoral tunnel and the percentage of femoral height (h) and length (t) to the total height and length respectively were calculated on the Bernhard Hertel quadrant and compared.

Results: The mean 'h' was 28.62 ± 7.68 (range 15.5 to 42), while mean of 't' was 34.86 ± 9 (range 21.5 to 55.5) in free hand method. The mean 'h' was 28.65 ± 10.19 (range 11.6 to 58), while mean of 't' was 31.6 ± 5.02 (range 21.8 to 44.4) in femoral offset guide method. On comparing mean of "h" of freehand method with the mean of "h" of offset guide method, the p value was 0.984 (p value > 0.05), which was not significant. Similarly, on comparing mean of "t" of freehand method with the mean of "t" of offset guide method, the p value was 0.230 (p value > 0.05), which was not significant.

Conclusion: Femoral tunnel preparation leads to almost similar tunnel position by both freehand and offset guide method. Both methods are associated with surgeon's learning curve. 3D CT-Scan and Bernhard Hertel grid is reliable and reproducible method for evaluating femoral tunnel.

Keywords: ACL Reconstruction, Femoral Tunnel placement, Bernhard Hertel quadrant, Free hand method, Offset guide method.

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Introduction

Arthroscopic ACL reconstruction has proven efficacy and a low morbidity profile. Techniques in ACL reconstruction have further improved significantly over the last several decades because of increased prevalence of these surgeries, better ACL understanding, intensive researches and studies on ACL and considerable attention on outcomes of ACL surgery. Current researches on ACL focus on tunnel positioning, graft choices, fixation methods and postoperative rehabilitation protocols [1,2]. Among various available graft options, hamstring is the most commonly used graft and is the preferred choice for arthroscopic ACL reconstruction [3].

Accurate tunnel placement and graft positioning are important for successful anterior cruciate ligament (ACL) reconstruction. Inaccurate femoral tunnel placement is among, one of the most frequent cause of errors in failed anterior cruciate ligament reconstructions [4,5]. In order to find the efficacy of placement of femoral tunnel, we compared the placement of graft in femoral tunnel by offset guide method versus free hand technique and assessed the femoral tunnel placement by post-operative 3D CT-scan.

Material and methods

30 patients of primary ACL tear, operated from June 2018 to April 2020 at our centre for arthroscopic ACL reconstruction were included in the study. The study was approved by institutional ethical review committee and written informed consent was obtained by all the patients. All patients undergoing primary ACL reconstruction with hamstring graft, with age more than 15 years and willing to give consent for surgery were included in the study. Patients with pre-existing congenital/developmental/collagen diseases, associated life threatening injury/illness, revision ACL reconstruction surgery, ACL injuries with avulsion injuries or associated intra-articular condylar fractures, arthritic knee or septic knee joint were excluded from study.

All patients were operated under spinal anaesthesia under tourniquet with use of hamstring graft for arthroscopic ACL reconstruction. Arthroscopic ACL reconstruction was done by standard steps. Femoral tunnel was made at the foot print of the native ACL after removal of its debris, with knee flexed at 120^0 or more. Guide wire was passed through the AM portal. The femoral tunnel was placed either with use 7^0 offset guide (fig1) or by free hand drilling technique of femoral tunnel under vision of arthroscope, camera unit and video screen along with continuous irrigation at optimum pressure which provided better visualization. The groups were randomized as per odd (offset guide) and even (free hand method) method. Guide wire was passed through AM portal and reaming done in proportion of thickness of graft obtained (fig 2).

Postoperatively standard post-operative rehabilitation protocol was followed. Post-operatively, 3D CT scan was done to determine the femoral tunnel positions by use of Bernard and Hertel quadrant method and 3D reconstruction model of distal femur were made using volume rendering technique (VRT). Initially, the distal femur model was positioned horizontally in strict lateral position, where both femoral condyles were superimposed. The model was then rotated to a distal view, and medial femoral condyle was virtually removed at the highest point of the anterior aperture of the intercondylar notch leaving lateral femoral condyle. Finally, the model was rotated back to the strict lateral position which provided end on view of medial wall of lateral femoral condyle and the femoral tunnel without any hindrance from medial condyle. Then the position of the centre of femoral tunnel was measured through Bernard and Hertel quadrant method. Total height (H) was measure of the perpendicular line from the Blumensaat line till the tip of articular end on condyle (proximal to distal). Total length (T) was measure of the parallel line to Blumensaat line at intercondylar point (from anterior to posterior). Femoral tunnel height (h’) and length (t’) was measured from the centre of the femoral tunnel on the perpendicular to the Bluemensaat line till the proximal end and on the parallel to the Bluemensaat line till the posterior end. Percentage of femoral tunnel centre height (h) and length (t) was measured in percentage as the ratio of femoral tunnel height (h’) to total height (H) and ratio of femoral tunnel length (t’) to total length (T) respectively (fig 3).

Result

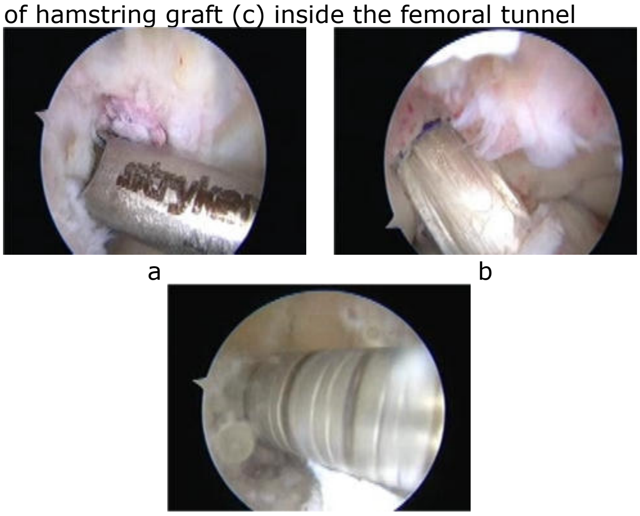
30 cases of arthroscopic ACL reconstruction using hamstring graft with mean age of 30.5 years (range 17 to 45 years) were included in the study. 26 patients were male (86.7%) and 4 females (13.3%). Left ACL tear was seen in 16 patients (53.3%) while right ACL tear was

seen in 14 patients (46.7%). 15 patients were there in each group of free hand technique and offset guide method.

In 15 patients of free hand method of femoral tunnel drilling, the mean percentage of femoral tunnel centre height 'h' was 28.62 ± 7.68 (range 15.5 to 42), while mean percentage of femoral tunnel centre length 't' was 34.86 ± 9 (range 21.5 to 55.5). In 15 patients of offset guide method of femoral tunnel drilling, the mean 'h' was 28.65 ± 10.19 (range 11.6 to 58), while mean of 't' was 31.6 ± 5.02 (range 21.8 to 44.4).

Fig 1. Femoral tunnel offset guides

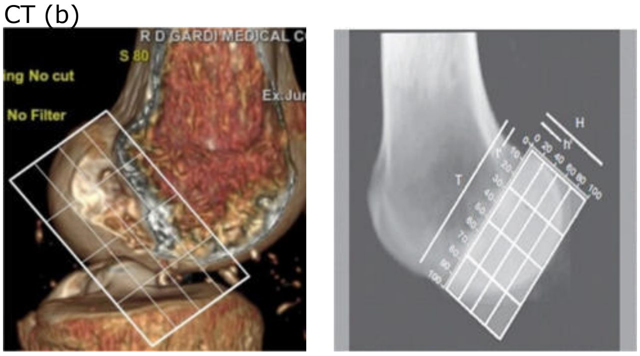
Fig 2. Intraoperative arthroscopic photos showing use of offset guide (a), for drilling (b) and passage of hamstring graft (c) inside the femoral tunnel



a b

c

Fig 3. Bernard and Hertel quadrant method on 3D CT reconstruction model (a) & on sagittal section of CT (b)



a b

On comparing means "h" (percentage of femoral tunnel centre height) of freehand method with the mean "h" of offset guide method, the p value was 0.984 (p value > 0.05), which was not significant. Similarly, on comparing means "t" (percentage of femoral tunnel centre length) of freehand method with the mean "t" of offset guide method, the p value was 0.230 (p value > 0.05), which was also not significant.

Table 1. Comparing femoral tunnel in different studies

Studies	h	t
Fernandes et al [11]	35.9±10.4	20.9± 3.6
Piefer et al [12]	44.2	28.5
Kim et al (expert surgeon) [13]	32.6± 4.3	30.5 ± 4.6
Kim et al (Novice surgeon) [13]	31.6± 4.6	32.5± 3.7
Kawaguchi et al [16]	31.7	32.4
In our study by free hand	**28.62± 7.7**	**34.86± 9**
In our study by offset guide method	**28.65± 10**	**31.66± 5**

Discussion

Tunnel positioning, graft choices, fixation methods and postoperative rehabilitation protocols are the key factors for the success of an arthroscopic ACL reconstruction [1-3]. Accurate femoral tunnel position is must for excellent outcome of ACL reconstruction. Among the causes of failed arthroscopic ACL reconstruction, inaccurate femoral tunnel positioning is one of the most frequent cause [4,5].

Various methods for femoral tunnel placement are anatomical landmark methods e.g. lateral bifurcated ridge, lateral intercondylar ridge etc but identifying these anatomic landmark in chronic ACL tear is challenging and these land marks may vary as shown by studies by Ferretti et al and Tsukada et al [6,7]. Free hand and offset guide methods are among the two most commonly performed methods for femoral tunnel positioning. Among various methods to assess the accuracy of femoral tunnel placement, Bernhard Hertel grid method by 3D CT scan is easy, reliable and reproducible method for assessing the femoral tunnel placement [6-11]. Placement methods of femoral tunnel positioning have not been compared and there is lack of consensus regarding the ideal method of femoral tunnel placement. Hence, in order to find the efficacy of methods of placement of femoral tunnel and to know the better method for tunnel placement, we compared offset guide method versus free hand technique for femoral tunnel placement in 30 cases of arthroscopic ACL reconstruction and assessed the accuracy of placement by post-operative 3D CT-scan by Bernhard hertel quadrant. We found that in free hand method of femoral tunnel drilling, the mean 'h' was 28.62 ± 7.68 (range 15.5 to 42), while mean 't' was 34.86 ± 9 (range 21.5 to 55.5), whereas in offset guide method of femoral tunnel drilling, the mean 'h' was 28.65± 10.19 (range 11.6 to 58), while mean 't' was 31.6 ± 5.02 (range 21.8 to 44.4). P value for difference in t and h by free hand and offset guide method came out to be 0.240 and 0.993 respectively (p value > 0.05), which wasn't significant, concluding that no significant difference was found in femoral tunnel placement by free hand method and offset guide method.

Inderhaug et al found intra-operative fluoroscopy can improve accuracy of tunnel positioning but it is associated with radiation exposure & increases duration of surgery [8]. Celentano et al and Hart et al reported that the anatomical centre of the ACL footprint could not be achieved using a femoral offset guide [9,10]. Tiago Lazzareti Fernandes et al found that 3D-CT protocol is an accurate and reproducible method that can be applied for ACL femoral tunnel or footprint measurement with high reliability [11]. Piefer et al in a systemic review analyzed the accuracy of placement of center of ACL, anatomically and radiologically and found that the centre of ACL foot print was located at mean t value of (proximal to distal) 28.5 (range 23.5 to 43.1) of length and mean h value of 35.2 (range 27.5 to 44.2) of height (h) in relation to Blumensaat line [12] (table 1).

Kim et al compared the efficacy of femoral tunnel position using a femoral offset guide during ACL reconstruction with AM portal, by an expert to a novice surgeon and found that results were almost same by both the surgeons. In their study, study value of t (proximal to distal) was 30.5 ± 4.6 by an expert surgeon and 32.5 ± 3.7 by a novice surgeon and study value of h (anterior to posterior) was 32.6 ± 4.3 for expert surgeon and 31.6 ± 4.6 for novice surgeon, hence they concluded that the femoral offset guide facilitates the accuracy and precision of the femoral tunnel placement, even by a novice surgeon [13]. Saurabh dutt et al found that there was no significant difference in drilling femoral tunnel with free hand or offset aimer, hence they concluded that dependency on aimer devices for femoral tunnel preparation can be reduced [14]. Tantuway et al found that commercially available off set guide technique of the femoral tunnel placement in arthroscopic ACL reconstruction is easy, reliable and reproducible with the foot print at anatomical place on the femoral site [15]. Kawaguchi et al compared the tunnel centre with the centre of the direct femoral attachment site of ACL and found that point in the femur were 32.4% from the proximal margin in the proximal–distal direction and 31.7% from the Blumensaat's line in the anterior-posterior direction [16].

Freehand drilling can give surgeon better manoeuvrability and tunnel position according to anatomy of the patient. The surgeon can confidently drill the tunnel freehand by keeping anatomical footprint and landmark in mind and achieve anatomic tunnel position especially in cases when the knee is small and when the anatomy is distorted, where the offset aimer's method can be faulty and put restraints. In our study, we found that both free hand and offset guide method of femoral tunnel drilling are equally effective and surgeon can drill the tunnel accurately by both the methods by keeping anatomical foot print in mind. In some cases, where knee is distorted, small or deviated from normal anatomy surgeon can prefer free hand or flexible offset guide which provide better manoeuvrability. Both methods have their learning curve and it totally depends on surgeon's experience and requirement of patient. The study is limited by smaller sample size; shorter follow-up and manual method of calculations which can be overcome by a larger sample size with longer duration follow up and automated software method for calculation.

Conclusion

Femoral tunnel positioning by both freehand and offset guide method leads to similar tunnel placement, but both the methods are associated with learning curve. 3D CT-Scan and Bernhard Hertel grid is reliable and reproducible method for evaluating femoral tunnel.

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To Evaluate the Functional Outcome of Platelet Rich Plasma Therapy in Osteoarthritis of Knee

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Abstract

Background: Osteoarthritis of knee is a chronic, degenerative condition associated with pain, deformity, disability, difficulty in movements and reduction in the quality of life. This study aims to assess the efficacy of intra-articular injection of autologous platelet rich plasma (PRP) therapy in the management of osteoarthritis of knee.

Material and methods: 50 patients with symptomatic knee osteoarthritis were treated by 5 ml autologous intra-articular PRP injection and were assessed for pain, quality of life and rate of satisfaction by WOMAC score.

Results: 50 cases (KL grade II 18 and grade III 22) were included in the study. In KL grade II, the mean WOMAC score, pretreatment was 57.11 ± 6.36, which improved to 53.76 ± 7.6 (p=0.000) at 2 weeks, to 31.97 ± 4.51 (p=0.001) at one month, to 26.97 ± 3.47(p=0.001) at 3 months and to 22.11 ± 2.99 (p=0.001) at final follow-up of 6 months. In KL grade III, the mean WOMAC score pretreatment was 59.21 ± 5.63, which improved to 55.76 ± 7.6 (p=0.000) at 2 weeks, to 48.79 ± 5.42 (p=0.001) at one month, to 36.46 ± 4.36 (p=0.001) at 3 months, and to 32.12 ± 2.66 (p=0.001) at final follow-up of 6 months.

Conclusion: Use of single PRP intra-articular injection in the management of osteoarthritis knee provides excellent pain relief, improvement in quality of life and high rate of satisfaction, which is more effective in the early stages of osteoarthritis than the advanced stage. Relief starts immediately and it increases gradually with time. PRP is a safe, easy, minimally invasive and cheap alternative in the management of knee osteoarthritis.

Keywords: Platelet rich plasma, Osteoarthritis, WOMAC score.

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Introduction

Osteoarthritis (OA) is a chronic degenerative disorder of synovial joints, which is characterized by progressive disintegration of articular cartilage, remodeling of adjacent bones by formation of new bone at joint margin (osteophytes), inflammation, sclerosis and cyst formation under the subchondral bone, synovitis and capsular fibrosis. This may be caused by any condition that can cause articular damages, and all unfavorable biomechanical conditions, which result in the mechanical overload that exceeds the ability of a joint to maintain itself [1]. Coexisting symptoms are joint stiffness, swelling, deformity, muscular fatigue, loss of function, and disability in the activities of daily living [2].

The goals for the treatment of osteoarthritis are pain relief, enhance joint mobility, prevention or correction of deformity, and slowing the disease progression process. NSAIDs and COX2 inhibitors provide symptomatic improvement in osteoarthritis but due to lack of proven disease-modifying potential, the relief is only temporary and the outcome deteriorates with time. Oral steroids decrease inflammation and have a role in reducing pain but due to side effects, they are not recommended for long-term use. Intra-articular injections of corticosteroids and visco-elastic supplementations have been tried but American Academy of Orthopedic Surgeons (AAOS) guidelines recently demonstrates inconclusive evidence and is against the use of hyaluronic acid visco-supplementation for patients with osteoarthritis knee [2-4].

Growth factors such as platelet derived growth factor (PDGF) and transforming growth factor beta (TGF-b) activate tissue healing and have the potential for bone and cartilage regeneration, changing the joint milieu and homeostasis. But genetically engineered growth factors are very expensive hence limits their clinical use. Autologous platelet rich plasma (PRP) contains a high concentration of these growth factors, which suppress inflammatory mediator concentrations and their gene expression and provokes healing and regeneration in synovium and cartilage tissue. This effect of PRP of improvement in pain score and early promising results has been demonstrated in some clinical series [5]. Hence we evaluated the efficacy & functional outcome of intra-articular injection of autologous platelet rich plasma therapy in the management of osteoarthritis of knee.

Material and methods

This prospective study was conducted on 50 consecutive patients with symptomatic knee osteoarthritis which were treated by intra-articular autologous PRP injection at our institute from 2018 to 2020. The study was approved by the institutional ethical review committee and written informed consent was obtained from all the participants.

Patients presenting to OPD with clinical symptoms of knee pain, knee joint effusion, and medial joint line tenderness were evaluated, and all these patients underwent knee joint AP and lateral weight bearing x-rays. Knee osteoarthritis was graded on these x rays as Kellgren and Lawrence classification (KL) of osteoarthritis knee [6]. Patients more than 40 years age with knee pain and joint tenderness having knee osteoarthritis of Kellgren-Lawrence classification grade II and III on weight bearing x-rays were included in the study. Patients with severe joint deformity (knee osteoarthritis KL grade IV), inflammatory or rheumatoid arthritis, hematological diseases (coagulopathies), infections or on immunosuppressive or anticoagulant therapy were excluded from the study.

Autologous PRP injection was prepared in the outpatient department itself by harvesting 30 ml of the patient's venous blood in acid citrate dextrose (ACD) vacutainers. The blood so collected was centrifugated in two steps, first at a lower rate of 2400 rpm for 10 mins, following this the obtained PRP containing platelets was poured into another sterile test tube (without anticoagulant). Then the second centrifugation was done for this test tube at 3600 rpm for 15 mins to get a platelet focus. From this centrifuged test tube the lower third platelet rich plasma (PRP) was isolated. Under all aseptic precautions, 5 ml of this PRP was injected using 18 G needle via a superolateral approach into the involved knee joint.

Post injection, all the patients were prescribed ice fomentation, locally and paracetamol orally along with range of motion exercises. All the patients were evaluated by WOMAC score (Western Ontario and Mac master universities osteoarthritis index) [5]. The results were described as the mean ± standard deviation (SD). ANOVA test, paired t test, chi-square test, and the simple regression analysis were used to analyze correlations between the factors. P-value less than 0.05 was considered statistically significant.

Results

50 cases of osteoarthritis knee treated with autologous PRP were included in the study. 37 (74%) patients were females and 13 (26%)

were males. The mean age in the study group was 52.02 ± 6.18 years (range 42 to 64 years). There were 12 (24.0%) patients in the age group 40 to 50 years, 20 (40%) patients were in the age group 51 to 60 years and 18 (36%) were more than 60 years. 38 (76.0%) patients had BMI > 25 kg/m^2. 32 (64.0%) patients had the K-L Grade III and 18 (36%) patients had K-L Grade II osteoarthritis.

In K-L grade II, the mean WOMAC score, pretreatment was 57.11 ± 6.36, which improved to 53.76 ± 7.6 (p=0.000) at 2 weeks, to 31.97 ± 4.51 (p=0.001) at one month, to 26.97 ± 3.47 (p=0.001) at 3 months and to 22.11 ± 2.99 (p=0.001) at final follow-up of 6 months. In K-L grade III, the mean WOMAC score pretreatment was 59.21 ± 5.63, which improved to 55.76 ± 7.6 (p=0.000) at 2 weeks, to 48.79 ± 5.42 (p=0.001) at one month, to 36.46 ± 4.36 (p=0.001) at 3 months, and to 32.12 ± 2.66 (p=0.001) at final follow-up of 6 months (table 1). All the patients were extremely satisfied with the treatment. We did not observe any adverse reactions or other possible serious complications after the PRP injection in any patient.

Table 1: Mean WOMAC score at different time intervals

Time interval	**K-L Grade II** (Mean ± SD)	**K-L Grade III** (Mean ± SD)	**P value**
Pre-treatment	57.11 ± 6.36	59.21+ 5.63	-
At 15 days	50.78 ± 7.61	55.76 + 7.6	0.000*
At 1 month	31.97 ± 4.51	48.79 + 5.42	0.001*
At 3 months	26.97 ± 3.47	36.46 + 4.36	0.001*
At 6 months	22.11 ± 2.99	32.12 + 2.66	0.001*

Discussion

The pathophysiology of osteoarthritis involves a combination of mechanical, cellular and biochemical processes, which lead to an imbalance in pro-inflammatory and anti-inflammatory cytokines. These cause changes in the composition and mechanical properties of the articular cartilage and finally leading to activation of proteolytic enzymes with destruction of articular cartilage [7-9]. Among various modalities of treatment of knee osteoarthritis, including conservative and surgical methods, recent treatments focuses on resolving these cytokine imbalances by using biologics [10-12].

Autologous platelet-rich plasma (PRP) contains a high quantity of growth factors including transforming growth factor-beta (TGF-b), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF), fibroblast growth factor (FGF), and hepatocyte growth factor (HGF) which accelerate the healing process and cell proliferation. These growth factors regulate the expression of the chondrocyte phenotype that may play an important role in disease progression. PRP inhibits the catabolism of articular cartilage which has been confirmed in study by Goldring [13].

Transforming growth factor-beta (TGF-b) present in PRP, increases expression of the chondrocyte phenotype and stimulates the differentiation of mesenchymal stem cells and stromal deposits and suppresses the synthesis of the cartilage glycoprotein and inflammatory mediator IL-1 [14,15]. Platelet-derived growth factor (PDGF) plays an important role in cartilage cell proliferation and maintenance of the cartilage phenotype by increasing the synthesis of glycoprotein [16]. Vascular endothelial growth factor (VEGF) plays a role to induce cartilage and insulin-like growth factor (IGF) stimulates the synthesis of glycoprotein and degrades its catabolism [17]. Fibroblast growth factor (FGF) and hepatocyte growth factor (HGF) are additional growth factors that function independently or in cooperation for the regeneration of articular cartilage metabolism [18]. Thus growth factors present in the PRP lead to the regeneration of cartilage and prevent the degenerative process.

We evaluated the outcome of intra-articular injection of autologous PRP in KL grade II and grade III osteoarthritis knee in 50 patients with a mean age of 52 years. These patients were assessed for healing of cartilage and reduction in inflammation indirectly, by improvement in pain, function and quality of life in osteoarthritis knee as assessed by WOMAC score. We found significant improvement in WOMAC scores from pre-treatment to final follow-up at 6 months in both grade II and grade III OA knee. Patient profile and demographics were almost comparable in our study to the reported studies of Filardo et al, Raeissadatet al, Patel et al and Srikanthet al [19-22]. Overall mean WOMAC score at final follow-up in our study was 28 (32 for grade III and 22 for grade II), whereas the mean score in the study by Rahimzadeh et al, Vamshi et al and Güvendi et al was 31, 23, and 24 respectively [23-25]. We also did not observe any adverse reactions or any other serious complications in our patients like in other series.

We included patients of only grade II and III OA knee for intra-articular autologous PRP injection therapy like all other series [20-25], except for series by Filardo et al and Meheux et al, who considered all grades of OA knee for intra-articular PRP injection [19,26]. This is because the PRP injections work better in the early stages of osteoarthritis knee and do not provide the expected benefit in advance osteoarthritis of knee. We also found better improvement in WOMAC score in grade II osteoarthritis compared to grade III, confirming that the PRP works better in the early stages of osteoarthritis rather than the advanced stage. Our study is limited by relatively shorter follow-up, small sample size, and absence of a control group.

Conclusion

Early osteoarthritis and relatively younger age are the appropriate conditions for treatment with autologous intra-articular PRP injection. PRP is a safe, easy, minimally invasive and cheaper alternative in the management of OA knee which provides not only excellent pain relief but also improvement in quality of life and high rate of satisfaction. The relief starts immediately and it increases gradually with time.

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Evaluation of percutaneous fixation of intra articular fractures of calcaneum using Essex Lopresti manoeuvre

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Study performed at Department of Orthopaedics, Mahatma Gandhi Memorial Medical College, Indore(M.P.)

Abstract

Background: Debate continues regarding the ideal management of calcaneal fractures, between open reduction and internal fixation and closed methods. Open plating has failed to prove its superiority over closed methods owing to poor soft tissue coverage, severe soft tissue swelling, lack of availability of sturdy implants and complications associated with plating. Hence we evaluated the outcome of percutaneous fixation of tongue type intra-articular fracture of calcaneum by Essex Loprestimanoeuvre.

Material and methods: 30 tongue type intra-articular fractures of calcaneum in 23 patients operated by Essex Loprestimanoeuvre by closed reduction and percutaneous pin fixation were assessed functionally by Maryland foot score and radiologically by Bohler's angle and Gissane's angle.

Results: 30 calcaneal fractures with mean age 31.6 years and mean follow up of 8.3 months were included in the study. The mean pre-operative Bohler's angle improved from 8.300 ± 3.84, to 24.470 ± 8.31 immediate postoperatively and to 24.330 ± 8.46 at final follow up of 6 months, respectively. The mean pre-operative Gissane's angle improved from 134.130 ± 7.03, to 123.150 ± 8.79 immediate postoperatively and to 123.550 ± 8.82 at final follow up of 6 months, respectively. Mean union time was 9 weeks. The mean Maryland Foot Score was 83.43 ± 7.53 (range 61 to 92) and 86 % cases had excellent to good results.

Conclusion: Essex-Lopresti's method for treatment of tongue-type fractures of calcaneum is easy, cost effective, day care procedure provides stable fixation, early mobilization and excellent results, with low complication rates.

Keywords: Tongue type calcaneal fracture, Bohler's Angle, Gissane's angle, Maryland Foot Score

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Introduction

Calcaneal fractures are the most common fractures of the foot and represent 1 to 2% of all fractures. Among these fractures, more than 75% fractures are intra-articular fractures, which are frequently associated with prolonged disability if not treated properly [1,2]. These fractures have a track record of being difficult to treat owing to position and nature of bone i.e. being subcutaneous, cancellous, weight bearing small bone and also due to peculiar fracture patterns i.e. severely communited, depressed and intra-articularfragments [3].Thus treatment of these calcaneal fractures require re–apposition of multiple fracture fragments and restoration of the subtalar joint anatomy, which is the interface between the calcaneus and talus and is the primary load bearing joint of the foot, along with providing respect to the thin subcutaneous tissuecovering overlying calcaneum [4].

Various modalities for the treatment of these fractures are plaster, plaster pins, external fixation, internal fixation by screws and plate. All these techniques have certain steps in common which include dis-impaction of the fragments, reduction of the displaced fragments along with joint restoration either manually or percutaneously and retaining the reduction alignment.Among the popularly used techniques, open methods have the significant issue of repeated surgeries, associated soft tissue trauma and high rate of wound healing problems while among the closed methods K-wires and pins have the advantage of easy implant removal without need of repeat surgery [5,6]. Hence we evaluated the outcome of close reduction and K-wire or pin fixation in30 tongue type intra-articular calcaneal fractures by Essex Loprestimanoeuver.

Material and methods

This study was conducted on 30 cases with tongue type intra-articular fractures of calcaneum treated by Essex Lopresti method at our institute. All patients of closed or grade 1 open tongue type intra-articular fractures of calcaneum, between 18 and 60 years of age, presenting within 2 weeks of injury were included in the study. All the patients with neurovascular injury, pathological fracture or other associated injuries were excluded from the study. The study was approved by the institutional review board and ethical committee of the institute and well explained written consent was obtained from all the participants.

All patients were primarily stabilized with intravenous fluids and analgesics. Standard axial and lateral calcaneal radiographs were taken and following this, abelow knee slab was applied, limb was elevated and ice fomentation was done, primarily to reduce the swelling. Analgesics and anti-inflammatory medications were given.

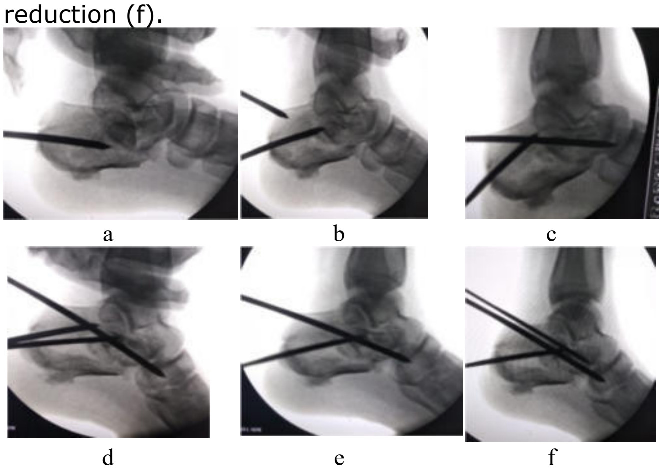
Patients were treated by percutaneous fixation of k wire / pin with Essex Loprestimanoeuvre[7,8]. All patients were operated, under the C-arm following all aseptic precautions in spinal anaesthesia in lateral position with affected limb above. Primarily aSteinmannpin or K-wire (3.0mm, 3.5 mm or 4.0 mm diameter with 9”length)was inserted from posterior calcaneal tuberosity and advanced till the fracture line keeping it just proximally to fracture line, without crossing the fracture (fig 1a). Reduction of the tongue type intra-articular calcaneum fracture was achieved by plantar flexion of the forefoot and down warding pulling of the pin / k wire from outside towards the planter surface to dis-impact the fragment by joy stickingto elevate the depressed tongue type fracture (fig 1b).Intra-operative, lateral and axial C-arm views were taken to confirm reduction and restoration of Bohler’s angle within normal range of 20^0-40^0. Once reduction was achieved, and depressed fragment was elevated, a second Steinmannpin was inserted from superior external side of calcaneal tuberosity towards tarsal bone, holding the reduction, passing across the fracture line and fixing both the fragments(fig 1c). Following this, a third pin or K- wire was inserted inferior to the first Steinmann pin for additional fracture fragment stabilization as well as fixation. Finally, the first joystickingpin / k wire was removed(fig 1d) and another k-wire was inserted from posterior of the calcaneum tuberosity, traversing the fracture fragment and reaching towards the tarsal bones(fig 1 ef). After confirming the reduction andpin placement in C arm, finally pin tract dressing was done and below knee cast was applied after shortening the pins with the help of Harrington rod cutter.

The limb was kept elevated and active toe movementswere started from second postoperative day. Oral analgesics and antibiotics were given for 5days. Cast care was explained to the patient as well as relatives. Patients were followed up regularly at 2 weeks each. Plaster and K-wires/pins were removed at 8 weeks and ankle range of motion started andfull weight was started at 12 weeks.Functional outcomeassessment was done by Maryland foot score and radiological outcome assessment was done by comparing restoration of Bohler's angle and Gissane'sangle, postoperatively [9,10].

Results

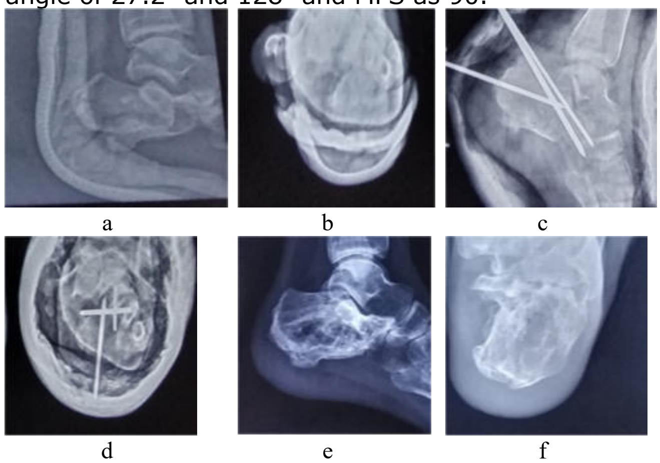
23 patientswith 30 calcaneal fractures treated with Essex Loprestimanoeuvre were included in the study. The mean age in our series was 31.6 years (range 18 to 54 years). 19 patients were male and 4 were female. 11 patients had fracture of left side, 5 had right side and 7 sustained bilateral fractures. The most common mechanism of injury was fall from height seen in 17 patients and 6 had road traffic accident. The mean follow up period was 8.3 months (range 6 to 12 months).

Fig 1. Intra-operative lateral fluoroscopic views (a to f) showing steps of Essex Loprestimanoeuvre – Insertion of first steinmann pin from posterior calcaneal tuberosity (a), achieving reduction by plantar flexion of forefoot and downward joysticking of the first pin (b), insertion of second and third steinmann pin from superior side of calcaneal tuberosity towards tarsal bone for holding the reduction (c & d), removal of first joysticking pin (e) and finally insertion of another pin to hold reduction (f).



The mean operative time was 12.86 minutes (range 8 to 20 minutes). The mean pre-operative Bohler's angle improved from 8.300±3.84, to 24.470 ± 8.31 immediate postoperatively and to 24.330±8.46 at final follow up of6 months, respectively. The mean pre-operative Gissane's angle improved from 134.130±7.03, to 123.150 ±8.79 immediate postoperatively and to 123.550 ± 8.82 at final follow up of 6 months, respectively (fig 2). Mean union time was 9 weeks (range 8 to 12 weeks). The mean Maryland Foot Score was 83.43 ± 7.53 (range 61 to 92). In 6 (20.0%) patients the Maryland Foot Score was excellent, in 20 (66.7%) patients it was good and in 4 (13.3%) patients it was fair.

Fig 2. Lateral (a) and axial (b) view of heel of 20-year-old male showing tongue type calcaneal fracture with preoperative Bohler's angle of 10.6^0&Gissane's angle of 133.7^0. Immediate postoperative lateral (c) and axial (d) views after Essex lopresti manoeuvre showing improved Bohler's&Gissane's angle to 26.8^0& 127.8^0 respectively. Final 6 months post-operatively lateral (e) & axial (f) views showing Bohler's and Gissane's angle of 27.2^0 and 128^0 and MFS as 90.



Complications associated with the procedure were implant loosening in 1 patient (3.3%) and subtalar arthritis in 2 patients (6.7%). None of the cases had infection or wound healing problems associated with the procedure.

Discussion

Calcaneal fractures are the most common foot fractures, accounting for approximately 2% of all fractures and 75% of all fractures of foot, of which 10% are bilateral, 10% have associated injuries and 75% are intra-articular fractures [1-5]. Debate continues regarding the ideal management of calcaneal fractures, between open reduction and internal fixation and closed methods. Open plating invariably leads to inconsistent results and had failed to prove its superiority over closed methods owing to poor soft tissue coverage, severe soft tissue swelling associated with the fracture, lack of availability of sturdy implants, complications associated with plating and comparatively poor functional outcomes [5,6].

30 tongue type intra-articular calcaneal fractures in 23 patients with mean age 31.6 years treated by Essex Loprestimanoeuvre

were included in the study. In our study, mean Maryland Foot score was 83.43 ± 7.53 with 86 % patients having excellent to good results and rest showing fair results and none of the patients had poor results. In two studies by Tornetta et al in 1998 and 2000, who had also treated these fractures by percutaneous fixation showed 85% cases having excellent to good results with15% having fair results and no patient having poor result as per Maryland Foot Score [11,12].

The mean MFS in study by Pillai et al and Scheppers et al was 77 and 79 respectively which was slightly less than that of our study, but the study by Parikh et al had mean score of 85 which was almost same as ours [5,13,14]. In all these studies, the number of patients with excellent to good results were comparable to our study with more than 80 % patients having excellent to good results. The mean correction achieved in Bohler's angle in our study was 16.270, which was comparable to other studies of Pillai et al, Scheppers et al, Parikh et al and Arastu et al who achieved correction ranging from 15^0 to 20^0 [5, 13-15].Pillai et al compared outcome of modified Essex Loprestimethod using Bohler'sstrip for reduction in tongue and depressed type intra-articular fractures and found that overall functional score was significantly better in tongue type group [5].

Various modifications ofEssex Loprestimethod to achieve accurate reduction of articular surface have been used and described by various authors like use of Bohler strip by Pillai et al, use of distractor by Scheppers et al, fixation of calcaneum fracture by screws by Parikh et al or use of elevator or laminar spreader to elevate the depressed fragment by Arastu et al [5,13-15]. All these methods have demonstrated that Essex Loprestimethod is an excellent method for reduction of tongue type fractures to achieve good restoration of hind foot morphology and provides excellent results.

Percutaneous fixation of calcaneal fracture by Essex Lopresti method has very short learning curve, does not demand much expertise, can be easily perfected, has very short surgical time and the technique can be safely performed even in presence of extensive soft tissue swelling i.e. even immediately following injury reducing the duration of hospitalization and burden on to the patient as well as on the healthcare system.

Conclusion

Essex-Lopresti's method of closed reduction and percutaneous pin fixation is a good treatment option for tongue-type intra-articular fractures ofcalcaneum which is easy to perform, requires average surgical skills, is cost effective day care procedure providing stable fixation, early mobilization and excellent results, with lower complications.

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Management of Sub-trochanteric Fractures by Long Proximal Femoral Nail in Young Adults

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Study performed at Department of Orthopaedics, Sri Aurobindo Medical Science & Post Graduate Institute, Indore (M.P.)

Abstract

Background: Sub-trochanteric fractures are difficult to manage and are frequently associated with complications, owing to high stresses in this region. We evaluated the outcome of long proximal femoral nailing in management of these sub-trochanteric fractures.

Material and methods: 32 patients of closed sub-trochanteric fractures of femur in patients more than 18 years' age were treated with long proximal femoral nail and were assessed functionally by Harris Hip Score and radiologically to assess union.

Results: 32 patients of sub-trochanteric fractures with mean age 50.09 years treated with long proximal femoral nailing were included in the study. 24 were male and 8 were female. Right side was affected in 18 cases and left in 14 cases. Mean operative blood loss was 122.6 ± 27.6 ml (range 110 to 143 ml). The mean union time was 14.37 weeks (range 12 to 24 weeks). The mean Harris Hip score was 85.9. Only one patient had complication in form of proximal screw back out.

Conclusion: Long proximal femoral nailing provides reliable and excellent to good results in the management of difficult sub-trochanteric fractures, with minimal complications, but the surgery is technically demanding and requires learning curve.

Keywords: Sub-trochanteric fracture, Proximal femoral nailing

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Introduction

Sub-trochanteric fractures are the fractures occurring in the area from just below the level of lesser trochanter to 5 cm distally in the shaft of femur [1]. These fractures typically occur at the junction between trabecular bone and cortical bone where the mechanical stresses across the junction are highest in the femur, hence these fractures are usually comminuted. In this region of femur, the stresses are further increased during activities of daily living by axial loading forces through the hip joint which create a large lever arm with significant lateral tensile stress and medial compressive loads. In addition to the bending forces, muscle forces at the hip also create torsional effects that lead to significant rotational shear forces. During normal activities of daily living, up to 6 times the body weight is transmitted to the sub-trochanteric region of the femur. As a result of these high forces in this area, the bone in this region is a thick cortical bone with less vascularity and has increased potential for healing disturbances. Hence, sub-trochanteric fractures are difficult to manage and are frequently associated with complications [3]. Management of these fractures by conservative methods poses difficulties in obtaining and maintaining a reduction, thus making operative management as the preferred treatment. The goal of operative treatment is restoration of normal length, alignment and angulation of the femur to restore adequate tension to the abductors and to start early mobilization and weight bearing [4]. Hence, the objective of this study was to determine the time to union, complications, operative risks and functional outcomes in sub-trochanteric fractures treated with long proximal femoral nail.

Material and methods

The study was conducted on 32 patients of sub-trochanteric fractures of femur treated with long proximal femoral nailing at our centre from 2018 to 2020. Institutional ethical committee approval and written informed consent was taken from all the patients prior to the study. All patients of closed sub-trochanteric fracture femur more than 18 years' age were included in the study. Open, pathological or fractures extending to intertrochanteric area were excluded from the study.

Patients were initially, hemo-dynamically stabilized and then X rays of the involved limb were taken. Fractures were classified according to Seinsheimer classification. Routine investigations were done and fitness for surgery was obtained. All patients underwent closed reduction and long proximal femoral nailing under spinal anaesthesia on fracture table under C-arm by standard method. Closed reduction of the fracture was achieved by traction and internal rotation primarily with mild adduction or abduction as required. Reduction was checked on a C-arm in both the views anterior-posterior and lateral. After achieving closed reduction, a 4 cm incision was given above the tip of the greater trochanter, deepened to clear muscle attachment and entry point was made with an awl over a protector sleeve on the tip of the greater trochanter and checked in both AP and lateral views. A flexible guide wire was passed and sequential reaming was done over the wire to know the diameter of the canal and the diameter of the nail to be used. The decided nail was mounted over the jig and was inserted into the femur till the desired depth, such that the position of the holes for the proximal screws directed over the head of the femur. Following this, both the proximal locking screws were passed via the jig and drill sleeve over the guide wire. The distal locking was done free hand with the help of image intensifier.

Postoperatively, antibiotics and analgesic were continued and suture removal was done after 2 weeks. Patients were encouraged to sit in the bed 24 hours after surgery. Quadriceps exercises and knee mobilization were started on the 2nd post-operative day. Patients were started on weight bearing depending on the pain tolerance. Patients were followed up regularly at 4 weeks interval till minimum of 6 months. Functional outcome of the patients was assessed by Harris Hip Score and radiological assessment was done to see union and implant placement.

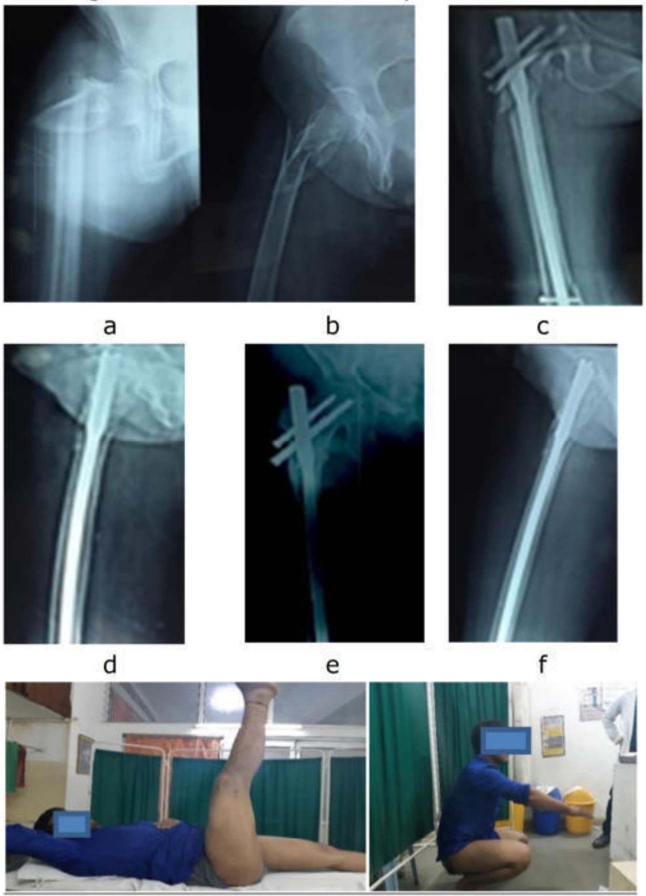
Result

32 patients of sub-trochanteric fractures of femur treated with long proximal femoral nailing were included in the study. The mean age was 50.09 years (range 20 to 80 years). 24 were male and 8 were female. Right side was affected in 18 cases and left in 14 cases.

The most common mode of injury was road traffic accidents accounting for 16 cases followed by fall from height in 7 cases and slip and fall in 9 cases. According to Seinsheimer classification, 6 cases were of type II A, 10 cases of type II B, 9 cases of type III A and 7 cases had type III B. Associated diabetes mellitus was seen in 4 patients, hypertension in 2 patients and coronary artery disease in 1 patient.

The mean duration of hospital stay following the surgery was 10 days. Mean operative blood loss was 122.6 ± 27.6 ml (range 110 to 143 ml). The mean union time was 14.37 weeks (range 12 to 24 weeks). All patients had improvement in the gait and daily activity in mean duration of 6 months (fig 1). The mean Hip Harris score was 85.9 with 10 patients having excellent results, 14 having good and 7 patients having fair results. Except for the one patient none of patient in our series had poor outcome. The only patient having poor outcome was the patient who had proximal screw back out, which was seen after 3 months of surgery.

Fig 1. Preoperative, immediate postoperative and one year follow up anterio-posterior (a,c,e) and lateral (b,d,f) X ray of sub-trochanteric fracture in 50 years male treated by long proximal femoral nail. Clinical photographs (g,h) of the patient showing excellent results at one year.



a b c d e f g h

Discussion

Sub-trochanteric fractures account for 10% to 34% of all hip fractures [2]. Owing to high stress area, these fractures are difficult to manage and treat and are frequently associated with complications. Debate still continues regarding the ideal management of these fractures and various range of implants are available. Long proximal femoral nailing has been recently widely used for the treatment of sub-trochanteric fractures.

We evaluated the functional outcome of sub-trochanteric fractures treated with intramedullary fixation using long proximal femoral nail in 32 patients with mean age of 50 years. All of our patients had significant improvement in pain, gait and activity of daily living. The findings of our study were similar to the published series by Parker et al, Chinoy MA et al, Herrera et al and Boldin et al [5-8].

Average union time in our series was 14.37 weeks which was almost comparable to the other series whereas union time in series by Harrington et al and Lechner et al was 17 weeks, which was slightly higher than that of our series [5-12]. Pelet & Arlettaz et al compared the results of intramedullary locking nails and blade plate in sub-trochanteric fractures and found that mean union time was 4.2 months in intramedullary locking nail group and was 5.3 months in blade plate group [13].

The mean period of hospital stay in our series was 10 days which was more than the other reported series [14], this was because these were geriatric patient and ours is a territory care centre and hence it took time for the patient to reach the operation theatre.

Our study showed that 65 % patients had good to excellent results and only one patient had poor outcome. The mean Harris hip score in our series was 86, which was almost comparable to reported series by Harshwardhan et al, Liu et al and Kashid et al [15-17]. Complications which we encountered in our series was only screw back out as seen in only one patient and rest all of our patients had satisfactory outcome with union seen in all the cases without any augmentation or any implant failure. Our series in limited by a small group, smaller follow up and lack of control group.

Conclusion

Long proximal femoral nailing provides reliable and excellent to good results in the management of difficult sub-trochanteric fractures, with minimal complications, but the surgery is technically demanding and requires learning curve. Proper patient selection and good preoperative planning are must before the surgery.

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Functional Outcome of Proximal Tibial Sagittal Fractures Treated with Minimally Invasive Plate Osteosynthesis

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Study performed at Department of Orthopaedics, Sri Aurobindo Medical Science and Post Graduate Institute, Indore (M.P.)

Abstract

Background: Tibial plateau fractures are common intra-articular fractures, representing 1-2% of all fractures. Modern locking plate systems provide increased angular stability, have a low implant profile, improved design matching the peri-articular bone surface and are compatible with minimally invasive techniques. We evaluated the functional outcome of tibial plateau sagittal fractures using a locking compression plate done via a minimally invasive technique.

Material and methods: 60 cases of sagittal plane proximal tibial fractures of Schatzker type I, IV, V, and VI fractures were treated using locking compression plate via minimally invasive techniques and were assessed for functional outcome by Modified Rasmussen's score.

Results: A total of 52 patients with a mean age of 43.71 years were included in the study (8 patients were lost in follow-up). 39 were male and 13 were female. 30 patients (58%) had excellent, 19 patients (36%) had good, 3 patients (6%) had fair functional outcome and none of the patients had a poor outcome. The mean Rasmussen score in the series was 25.85.

Conclusion: Internal fixation of proximal tibial sagittal fractures with locking plates, following the principles of MIPO (Minimally invasive percutaneous osteosynthesis) provides, satisfactory fracture reduction, less damage to soft tissues, allows early mobilization and excellent to good functional outcome even in these complex tibial plateau sagittal fractures.

Keywords: Tibial plateau fracture, Locking compression plate, Proximal tibial fracture

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Introduction

Proximal tibial fractures account for 5-11% of all tibia fractures. These fractures are quite challenging to manage because they are associated with severe soft tissue injuries and are notoriously difficult to reduce, align and stabilize [1-3]. These fractures usually result from direct axial compression, with a valgus (more commonly) or varus movement along with indirect shear forces [4,5]. Schatzker classification is the most commonly used classification as it defines the patho-anatomy of the fracture and suggests optimal treatment strategies. A new CT scan-based classification system was recently developed that takes into account the medial, lateral and posterior aspects of the tibial plateau which provides accurate delineation of all significant fracture planes. This column based classification also helps in pre-operative planning, for the treatment of these fractures [6].

Conservative treatment of proximal tibial fractures is commonly associated with problems of knee stiffness, prolonged treatment, mal-union, deformity, and arthritis [7,8]. Conventional open plating may lead to reduction loss, loosening of the implant, wound infections, skin necrosis, and extensive soft tissue dissection. External stabilization with pins and rods may cause pin site infections, septic arthritis, malunion, and deformity. Minimally invasive percutaneous plate osteosynthesis techniques (MIPO) overcome these complications and have led to improvement in the outcome of these fractures owing to the advantages of indirect reduction technique, preservation of soft tissues, and vascularity of the bone, preservation of the osteogenic hematoma, and improved quality of fixation with locking compression plates. We evaluated the functional outcome of proximal tibial sagittal fractures treated with a locking compression plate done by minimally invasive percutaneous plate osteosynthesis.

Material and methods

This study was conducted at our center from September 2018 to July 2020 in 60 patients of proximal tibial sagittal fractures treated by locking compression plate using a minimally invasive approach. The study was approved by the institutional ethical review committee and written informed consent was obtained from all the participants.

All patients of closed proximal tibial sagittal fractures of more than 18 years of age with Schatzker type I, IV, V, or VI i.e. sagittal plane fracture without depression were included in the study. Fractures with associated neurovascular injury, Schatzker type II or III (depressed fracture which needed elevation of the fragment), open or pathological fractures were excluded from the study.

After stabilizing the patient haemo-dynamically and primary care, patients were assessed radiologically by standard AP and lateral views, and a CT scan of the involved knee joint was done. The fractured limb was initially immobilized with above-knee slab application and was kept elevated over Bohler-Braun splint to decrease the swelling. Preoperative investigations were done and fitness for surgery was obtained. Minimal invasive plate osteosynthesis by locking compression plate was planned for all the patients, once the swelling subsided.

All patients were operated in a supine position with a bolster under the knee in spinal anesthesia under a tourniquet via minimal invasive anterolateral approach using single proximal and multiple distal stab incisions. Under the guidance of the image intensifier, the fracture was reduced closed or by using k wire joysticking technique and following this a submuscular single lateral hockey locking plate was slided over the periosteum and fixed with appropriate size locking screws, both proximally and distally (fig 1).

Post-operatively, the patients were mobilized with knee range of motion from day two. Initially, partial weight-bearing was started which gradually progressed to full weight-bearing as per the pain tolerance. Functional outcome was assessed by Modified Rasmussen’s score and pain, walking capacity, knee extension range of motion, stability, and power of quadriceps were also assessed. The Chi-Square test was used to calculate the statistical significance and a probability value of <0.05 was considered significant.

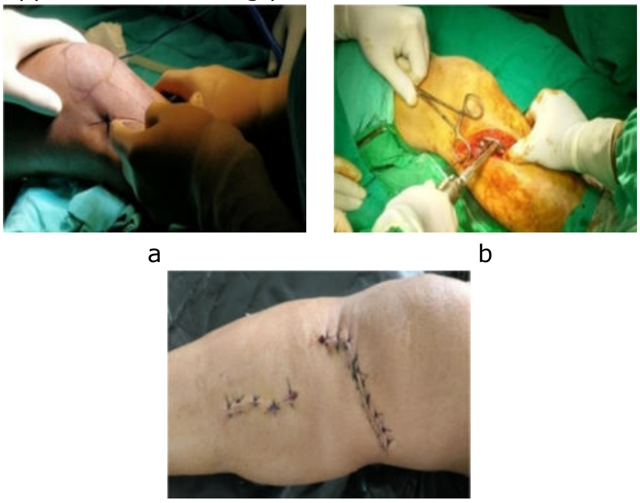
Result

60 patients with proximal tibia sagittal plane fractures treated with minimal invasive plating were included in the study. 8 patients were lost to follow-up and hence 52 patients were available for assessment at final follow-up. The mean age of the patients was 43.71years (range 24 to 69 years). 39 were male and 13 were female. 30 patients sustained an injury on the right side whereas 22 patients had an injury on the left side. The most common mode of injury was road traffic accident as seen in 45 patients whereas 7 had an injury due to fall from height. Schatzker type I, IV, V, and VI fracture was seen in 20, 7, 16, and 9 patients, respectively.

The mean duration of surgery was 73.09 min (range 67 min to 84 min). Union was seen in all patients in a mean duration of 13.30 weeks (range 9 to 18 weeks). The mean Rasmussen score was 25.85 (range 24 to 28). At the final follow-up, 30 (58%) patients had excellent outcomes, 19 (36%) patients had a good outcome and 3 (6%) patients had a fair outcome. None of the patients in our series had poor outcome (fig 2). The time to union and functional outcome by Rasmussen score as per the Schatzker classification is given in table 1.

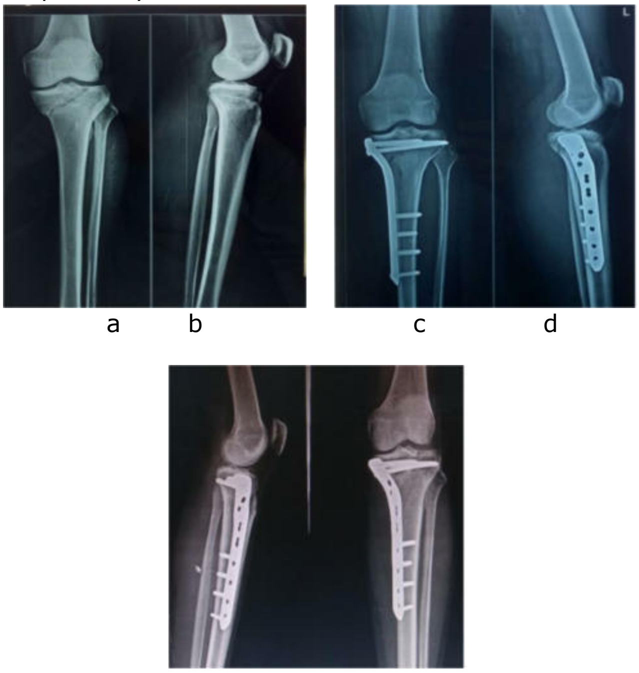
Complications seen were knee stiffness in one case and wound dehiscence in one case, both of which were managed by physiotherapy and conservative treatment by regular dressing, respectively. Two of our patients had infection, of which one required implant removal whereas the other healed with dressing and antibiotics only.

Fig 1. Intra-operative clinical photographs (a to c) demonstrating minimal invasive anterolateral approach and locking plate fixation.



a b c

Fig 2. Pre-operative (a,b), immediate postoperative (c,d), and 1-year final follow-up (e,f) anteroposterior and lateral X-ray of tibial plateau fracture treated by MIPO locking plating, respectively.



a b c d e f

Table 1. Union time and functional outcome as per the Schatzker classification

Schatzker classification	No of patient	Time of union (in wk)	Mean Rasmussen score
Type I	20	10	28.2
Type IV	07	14.85	27
Type V	16	15.75	26.56
Type VI	09	15.11	25.3

Table 2. Comparison of our results with other studies

S.No	Author	Year	Patients	Criteria	Follow up (in month)	Complications	Results
1	Our study	2021	52	Rasmussen	12	1 case (knee stiffness) 2 cases (deep seated infection) 1 case (wound dehiscence)	95%
2	Biggi et al [8]	2010	58	Rasmussen	18	3 cases (non-union)	78%
3	Raza et al [9]	2012	41	Rasmussen	12	1 case (late onset deep infection)	90%
4	Rambold [10]	1960	30	Lansingers	6	None	93%
5	Honkonen [11]	1994	60	Rasmussen	6	2 cases (knee stiffness) 1 case (malunion) 3 cases (infection & wound dehiscence)	86%
6	Schatzker [12]	1979	30	Rasmussen	6	3 cases (Knee stiffness)	86%
7	Prasad [13]	2015	30	Rasmussen	6	None	83.4%

Discussion

Management of tibial plateau fractures requires anatomical reduction, rigid fixation, and early mobilization. Conventional non-locking plating has a high rate of complications owing to the fact that it requires open reduction, extensive soft tissue dissection, high wound healing complication, provides poor stability, loosening of the implant, loss of reduction, delayed mobilization, and knee stiffness. Locking plate by virtue of its features, like increased stability, minimally invasive approach, indirect reduction, anatomically pre-contoured shape and preservation of soft tissue have given excellent results [4,5].

We evaluated the outcome of 52 proximal tibial sagittal fractures treated with minimally invasive percutaneous plate osteosynthesis with a mean age of 43 years and found that more than 90 % of the patients had excellent to a good outcome and none of the patients had poor outcome as per Rasmussen criteria. In our series, the mean score was 25.85 at the final follow-up of 12 months, and the mean union time was 13.30 weeks.

The patient profile in our study was almost comparable to the studies by Biggi et al, Raza et al, Rombold et al, Honkonen et al and Schatzker et al in respect to mean age, number of patients, male to female ratio, and mode of injury (table 2) [8-12]. But results in our study were marginally better than these studies because we included only sagittal plane fractures in our study that included Schatzkertype I, IV, V and VI and have excluded type II and type III (depressed) fractures. While other studies have included all types of fractures. Type II and III fractures typically involve a depressed fragment and management of these fractures needs elevation of the depressed fragment and buttress below the fragment to prevent the re-depression.

The complications in our study, were also marginally lower than the complications as seen with other studies [13-23]. Complications found in our study were stiffness and wound dehiscence in one patient each. A patient with stiffness was treated by a range of motion exercise whereas a patient with wound dehiscence was treated by regular dressing, on which the wound healed. Infection was seen in two of our patients, which was treated by implant removal in one patient and regular dressing and antibiotics in another. Both of which healed well. Tibia being a subcutaneous bone and tibial plateau fractures being associated with severe soft tissue trauma, the internal fixation of the proximal tibia fractures is associated with severe wound healing-related complications. Minimal invasive plate osteosynthesis provides advantages of greater stability, with minimal damage to the soft tissue envelope. Hence it provides early rehabilitation, early return to the range of motion with the early union, and hence excellent results as seen in our study. Our study is limited by shorter follow-up, lesser number of patients and lack of control group.

Conclusion

Tibial plateau fractures treated by minimally invasive plate osteosynthesis result in rapid healing of fractures without many wounds healing problems due to lesser tissue damage, preservation of fragment vascularity and minimal disturbance of fracture site biology. It also provides increased stability and early rehabilitation due to the use of locked plates.

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A case of congenital pseudoarthrosis tibia treated by four in one procedure and review of literature

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Abstract

Case report: Standard methods of treatment for congenital pseudoarthrosis of tibia (CPT) including internal fixation with intramedullary rodding, external fixation or ilizarov fixation, vascularized fibula transfer or combinations have varied results with high rates of recurrence. We report such a rare case of congenital pseudoarthrosis tibia which failed to unite with primary surgery of ilizarov and then was successfully treated and united with four in one procedure which involves creating a synostosis between proximal and distal ends of both tibia and fibula. The procedure is reliable and effective in preventing re-fractures.

Keywords: Congenital pseudoarthrosis tibia, Four in one procedure, Tibia fibula synostosis

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Introduction

Congenital pseudoarthrosis of tibia (CPT) is a very rare condition, with incidence of about 1 in 25000 live birth [1]. It is most commonly associated with neurofibromatosis type 1 in more than 50 % of the cases [1]. It has also been associated to fibrous dysplasia or Campanacci's osteofibrous dysplasia [2].

Loss of neurofibromin protein and presence of hamartomas are the primary pathologies in neurofibromatosis that prevents osteoblastic differentiation, bone remodeling or fracture healing. The soft tissue at the pseudarthrotic site is composed of variable admixture of fibrous tissue, fibrocartilage, and hyaline cartilage with evidence of enchondral ossification [3].

Standard methods of treatment for CPT including internal fixation with intramedullary rodding, external fixation or ilizarov fixation, vascularized fibula transfer or combinations have varied results with high rate of recurrence [4-9]. 4 in 1 osteosynthesis used to treat CPT, involves creating a synostosis between proximal and distal ends of both tibia and fibula [10, 11]. We report such a rare case of congenital pseudoarthrosis tibia which failed to unite with primary surgery of ilizarov and then was successfully treated and united with four in one procedure and also reviewed the literature on the topic.

Case report

A 5-year-old female child, presented in our outpatient department, with chief complain of deformity, shortening of right leg and inability to bear weight on affected right leg since birth. The child was delivered at full term with normal vaginal delivery. She had history of full immunization as per the national immunization schedule. Parents and child denied any other significant past medical history. Familial history was unremarkable for any other congenital disorder. As per the parents, some deformity of right leg was noticed during the neonatal period but no treatment was taken. Child achieved all milestones at appropriate age except for ambulation, which was delayed. Child had a history of trivial trauma due to fall while playing 2 months back and had been non ambulatory since then.

On clinical examination, distal fourth right leg was deformed with severe bowing and procurvatum deformity of about 90^0 (fig 1). There were clear signs of non-union of fracture of tibia and fibula with frank painless abnormal mobility present in all the planes at lower third leg. The leg musculature was severely hypotrophied. Proximal end of bone was dimpling the skin which appeared smooth and shiny. On palpation local temperature was comparable on both sides. Distal pulsations of dorsalis pedis artery and posterior tibial arteries were palpable. Ipsilateral hip and knee examination were unremarkable but active movements of ipsilateral ankle were restricted. Shortening of about 5 cm was present on the right side. No other deformities were seen anywhere else in the body.

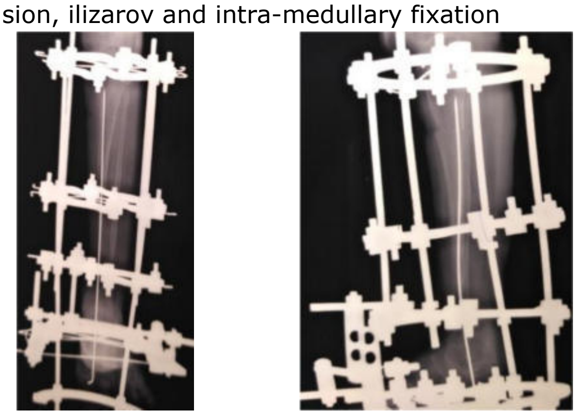
Routine radiographs of the limb including AP and lateral views were done which showed pencil thin severely hypotrophied tibia fibula with clear fracture at level of lower third leg. The bone ends were atrophic and thinned out. Severe angular deformity was present at the fracture site and ankle seen in severe calcaneus position. The knee joint appeared normal.

After routine hematological work up and pre anesthetic check-up patient was primarily treated by excision of hamartomatous tissue along with ilizarov application, corticotomy and intramedullary rod fixation to achieve union and prevent refracture (fig 2). After 4 months of bone transport and compression at fracture site, the pseudoarthrosis failed to show signs of union, although good regenerate bone was formed at corticotomy site. Illizarov was removed and patient was planned for re-surgery with four in one osteosynthesis technique to achieve a tibio fibular synostosis (fig 3). Copious amount of cortico-cancellous bone graft was obtained from the ipsilateral iliac crest. Utilizing the previous incision, the pseudoarthrosis site was exposed and remnants of fibrous periosteal and hamartomatous tissue were removed (fig 4). Both ends i.e. proximal and distal ends of the both the bones tibia and fibula were freshened and the copious amount of cortico-cancellous auto-graft was placed between the tibia fibula to achieve a synostosis between tibia and fibula both proximally and distally. An external fixator was applied and trans-calcaneal intramedullary rush nail was also fixed to protect the union. Postoperatively, regular pin tract dressings were done. Patient was followed regularly to confirm an uneventful postoperative period. External fixator was removed after 6 months' post operatively. The Child achieved union at pseudoarthrosis site at 9 months, but had limb length discrepancy and is explained and planned for limb lengthening once she attains maturity (fig 5).

Fig-1. Antero-posterior (a) and lateral (b) X rays and pre-operative clinical photograph (c) of the patient showing typical features of congenital pseudoarthrosis tibia.

a b c

Fig-2. Antero-posterior (a) and lateral (b) X rays after primary surgery by hamartomatous tissue excision, ilizarov and intra-medullary fixation



a b

Fig-3. Antero-posterior (a) and lateral (b) X rays after ilizarov removal showing the nonunion.

a

b

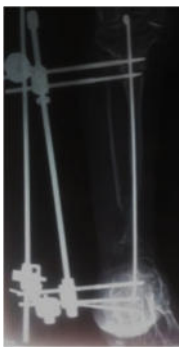
Fig-4. Intra-operative photographs (a), antero-posterior (b) and lateral (c) X rays of 4 in 1 procedure showing cortico-cancellous auto-graft between the tibia fibula to achieve a synostosisand external fixator with trans-calcaneal intramedullary rush nail in place.

a

b

c

Fig-5. 8 months follow up antero-posterior (b) and lateral (c) X rays after 4 in 1 procedure showing sound union after external fixator removal.



a

b

Discussion

Congenital pseudoarthrosis tibia, often associated with neurofibromatosis type 1, is a progressive disorder that has troubled orthopedicians for more than a century [3]. Many theories have been given with regards to pathogenesis of the disease. As per McElvenny's thickened, adherent periosteum which constricts tibia-fibula is the cause of atrophy, fracture and pseudarthrosis [12]. Boyd demonstrated osteolytic fibromatosis as the cause of CPT from a study of amputated specimens [13]. Codivilla was the first to recognize that the periosteum in CPT is diseased and he recommended osteo-periosteal grafting as the treatment [14].

The natural history of CPT is quite unfavorable and results are seldom optimal. The deformity progresses from anterolateral bowing at birth to eventual fracture of tibia fibula which fails to unite. Fracture of tibia lead to absence of weight bearing bone and instability. Fracture of fibula causes proximal migration and valgus at ankle joint. The anterior bow of the tibia causes the foot to assume a severe dorsi-flexed or calcaneus position of the ankle. Due to lack of loading of distal tibia physis the growth rate is reduced causing limb length discrepancy and atrophy of the bones and muscles [13]. Also there is compensatory overgrowth of femur as well as coxa valga that may even cause hip dysplasia.

Many classifications of CPT have been described. Boyd classified CPT into 6 types with type 1 being anterior bowing of tibia, type 2 is the most common type with hourglass constriction, type 3 is cystic lesions of tibia, type 4 is sclerotic lesion with stress fractures, type 5 includes dysplastic fibula and type 6 is intra-osseousneurofibroma [13].Crawford classified CPT into 4 categories. Type 1, non-dysplastic type with anterolateral bowing of tibia with cortical thickening at apex of deformity but medullary canal is preserved; type 2, dysplastic type with anterolateral bowing and narrowing of medullary canal; type 3, cystic lesions present in tibia along with deformity and type 4, pseudoarthrosis [15]. None of these classifications consider the status of the fibula, which plays a role and also a key factor in the pathology and management of CPT. Choi classification was the first to highlight the important consideration of proximal fibular migration [16]. Although they documented the fibular migration, Choi et al did not recommend any treatment for this.

Child with CPT presents with mild deformity i.e. anterolateral bowing of tibia, which is present since birth. The deformity eventually progresses and results in moderate to severe bowing and atrophy of bone, which ends into fracture of tibia and fibula which fails to unite [1,12]. Foot deformity, leg-length discrepancy (LLD), knee malalignment and even hip dysplasia due to valgus deformity of the proximal femur are myriad of conditions that are all considered part of the natural history of CPT due to involvement of fibula causing valgus [10]. Our patient also presented with similar complains of nonunion of tibia and fibula with severe deformity and hypotrophy of leg musculature and bone along with ankle dorsiflexion deformity.

If the child presents early with just bowing of tibia, then treatment is focused on preventing the fracture using bracing. Adjunctive treatments such as bisphosphonates, Bone Morphogenic Protein (BMP 2, 7) and electric stimulation have also been used [3]. Once the bone has fractured non-union is the rule and surgery remains the only choice of treatment. Primary objective of surgery is to obtain and maintain union at fracture site and secondarily correct the bowing of tibia and prevent proximal fibular migration [10]. The standard methods of treatment for CPT include: internal fixation with intramedullary rodding [4, 5], external fixation (predominantly ilizarov apparatus), combination treatment with an ilizarov and rodding construct [6, 7] or vascularized fibula transfer [8, 9]. Excision of fibrous hamartoma is often used along with these procedures. The results of these procedures are varied with high rate of recurrence of fracture and no consensus exists, on what surgery offers best union rates and least recurrence or on the appropriate age of surgery [10]. We also considered our patients primarily for excision of the hamartomatous tissue and ilizarov, but failed to achieve desired results.

A newer modality of treatment termed as 4 in 1 osteosynthesis as suggested by Choi et al has been used in atrophic type CPT. It involves creating and achieving a synostosis between the proximal and distal ends of tibia and fibula by use of bone grafts. The procedure has yielded favorable results and has been effective in preventing re-fractures in almost 100% patients [10, 11]. By the procedure we could also achieve union and synostosis for the pseudoarthrotic site, although we still are skeptical to remove the intra-meduallary rod and are planning for limb lengthening. Amputation remains the salvage procedure when all the treatment modalities have failed and articular functions are compromised.

Conclusion

Congenital pseudoarthrosis of tibia is a rare pediatric disorder in which fibrous hamartomatous tissue between the bones ends leads to formation of pseudoarthrosis. The entity is difficult to treat with high rate of recurrence with standard treatments. 4 in 1 osteosynthesis which involves creating and achieving a synostosis between the proximal and distal ends of tibia and fibula by use of bone grafts is a reliable and effective procedure in preventing re-fractures.

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Prof. D. K. Sonkar

(1965-2021)

"A great teacher is not a man who supplies the most facts,

but the one in whose presence we become different people"

Our community sadly lost a pillar on 15th January 2021, when Prof. Dinesh K Sonkar left for his heavenly abode at the age of 55 years after a valiant battle with Neck Cancer.

Prof Dinesh Sonkar was born on 15th September 1965 at Bina (District Sagar), Madhya Pradesh. After completing his basic schooling from Bina, he joined as an MBBS student at MGM Medical College, Indore where he completed his graduation and post-graduation (M.S Orthopaedics) in the year 1989 and 1992 respectively. During his graduation, owing to his commitment to physical fitness, competitive sports and great singing and oratory skills, he was awarded with the reputed Mr MGM Award.

After completing his post-graduation in Orthopaedics, he served his alma mater as Senior Registrar from 1994 till 1996. He was selected as Assistant Professor, Orthopaedics at MGM Medical College, Indore through MPPSC in September 1997. During his tenure as Assistant Professor his paper on the innovative "Indore shoe" for maintenance of clubfoot was shortlisted for the prestigious A.A Mehta Gold Medal Paper competition at IOACON, Jaipur 2000. This innovation got appreciation all over the country bringing recognition to the department and Indore.

He held the post of Associate Professor at MGMMC, Indore from 2003 to 2007 when his discipline towards work, incredible surgical skills, his ability to execute a variety of complex surgical procedures in a perceptibly simple way and his dedication to undergraduate and postgraduate teaching got admiration amongst his colleagues and students.

He served as Professor and Head of the Department at SRS Medical College, Rewa from 2007 to 2010. It was under his able leadership that the Post Graduate Degree Course got recognised by M.C.I at SS Medical College, Rewa. His tenure at Bundelkhand Medical College, Sagar from 2010 till 2013, laid the keystone for building from scratch, the Orthopaedic department at Bundelkhand Medical College. He led the department from the front and expanded its horizon by demonstrating various novel orthopaedic procedures like arthroplasty and spine surgery.

He joined as Professor, Orthopaedics at MGM Medical College, Indore in 2013, where he was promoted as the head of department after the retirement of his predecessor Dr Pradip Bhargava in 2014. Under his headship the department organized the National Postgraduate Teaching Course during IOACON

2017 at MGM Medical College, Indore. He was also the Organizing chairman for the 1st Alumni meet organized by Department of Orthopaedics in December 2017.

He was also the Principal of School of Physiotherapy till it became a part of MGM Allied Health Sciences Institute (MAHSI) in 2018. It was under his able supervision that Artificial Limb Fitting Centre (ALFC) got unparalleled reputation amongst the fraternity for offering good quality rehab aids for specially abled in Indore and its vicinity.

He has also been the President of Indore Orthopaedics association from 2015-16, which was a landmark year in the history of the association.

He has to his credit, presenting many research papers; countless faculty lectures and publishing several research papers in international, national and state level journals of repute. He chaired sessions in various national and state level conferences educating presenters from all parts of the country.

He was a problem solver and often took the difficult projects willingly and completed them with much ease. He has been a great teacher, enlightening the path for most of us.

Prof Dinesh Sonkar is survived by his wife Smt Tara Sonkar and two sons, Harsh vardhan and Yash vardhan Sonkar. Yashvardhan is pursuing MBBS from MGM Medical College, Indore and carrying forward his father's dream.

His legacy will live in the hearts and minds of everyone he interacted with as well as those he reached as a teacher.

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ORTHOPAEDIC JOURNAL OF M. P. CHAPTER

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A series of cases can also be considered as brief report, provided the number of cases is reasonably large. Abstract should be 100-150 words with 3-5 keywords. Text should not contain more than 1500 words.

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Authors: The full names, qualifications, designation and affiliations of all authors should be listed at the beginning of the article. E mail id of all author is must. Your Manuscript should be typed, double-spaced on standard-sized – A 4 paper with 1" margins on all sides. You should use 12pt Arial font for manuscript, Subheadings should be in 12 point Bold Arial.

A research paper typically should include in the following order

Abstract : (Limit of 250 Words) a brief summary of the research. The abstract should include a brief introduction, a description of the hypothesis tested, the approach used to test the hypothesis, the results seen and the conclusions of the work. It can be a structured like Background, Methods, Results, Conclusion.

Key Words: write no more than six keywords. Write specific keywords. They should be written left aligned, arranged alphabetically in 12pt Arial.

Introduction: Description of the research area, pertinent background information, and the hypotheses tested in the study should be included under this section. The introduction should provide sufficient background information such that a scientifically literate reader can understand and appreciate the experiments to be described. The specific aims of the project should be identified along with a rationale for the specific experiments and other work performed.

Material & Methods: Materials and/or subjects utilized in the study as well as the procedures undertaken to complete the work. The methods should be described in sufficient detail such that they could be repeated by a competent researcher. The statistical tool used to analyze the data should be mentioned. All procedures involving experimental animals or human subjects must accompany with statement on necessary ethical approval from appropriate ethics committee.

Results: Data acquired from the research with appropriate statistical analysis described in the methods section should be included in this section. Results should be organized into figures and tables with descriptive captions. Qualitative as well as quantitative results should be included if applicable.

Discussion: This section should relate the results section to current understanding of the scientific problems being investigated in the field. Description of relevant references to other work/s in the field should be included here. This section also allows you to discuss the significance of your results - i.e. does the data support the hypotheses you set out to test? This section should end with new answers/questions that arise as a result of your work.

Conclusion: This should have statement regarding conclusion drawn from your study only.

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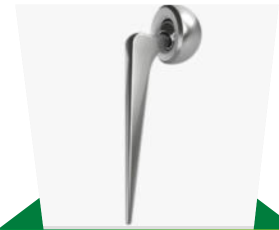

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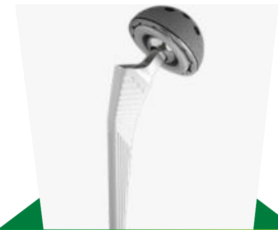

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