ORTHOPAEDIC JOURNAL OF M. P. CHAPTER

An official publication of Madhya Pradesh Chapter of Indian Orthopaedic Association

P-ISSN 2320-6993 | E-ISSN 2582-7243

www.ojmpc.com

Index Copernicus International
ICV 71.64
Indexed

2022 Jan-Jun

Volume 28

Issue 1

Special Task Force
to
Counter Attack Tough Pathogens

STF-625

Amoxycilin & Potassium Clavulanate with LB Tabs

Available in Mono carton pack of 6 Tab.

To Counter Attack Severe Bacterial Infection

CEFGEM-T™

1.125 / Kid Inj.
(Ceftriaxone + Tazobactum Inj.)

The Powerful Coalition Forces

CEFGEM-PT™ INJ.

(Piperacilline 4gm & Tazobactum 0.5gm Injection)

Strike Hard !!!

Lextra Pharmaceuticals

Let's give Life an extra boost !

EDITORIAL TEAM

M.P. ORTHOPAEDICS ASSOCIATION
2021-22

PRESIDENT	Dr Pramod Neema, Indore
PRESIDENT ELECT	Dr Suneet Tondon
PAST PRESIDENT	Dr R K S Dhakad
VICE PRESIDENT	Dr Abhijeet Mukherjee Dr D K Sharma
SECRETARY	Dr. Saket Jati, Indore
PAST SECRETARY	Dr. Deepak S. Maravi, Bhopal
JOINT SECRETARY	Dr. Manish Maheshwari, Indore Dr. Dipendra Sonkar, Bhopal
TREASURER	Dr. Akhil Bansal
EDITOR OJMPC	Dr. Vivek Singh, Ujjain
WEBMASTER	Dr. Pradeep Chaudhary, Indore
ASSIST SURGEON WELFARE COMMITTEE	Dr. D. K. Sharma, Indore
EXECUTIVE MEMBERS	Dr G P Tiwari Dr Atul Warshney Dr Mahesh Marmat Dr Vijay Harlaka Dr Y S Chahar Dr Manish Bajaj Dr Surendra Yadav Dr Arvind Verma Dr Jatin Dhirwani
ADVISOR	Dr. D. K. Taneja Dr. N. Shrivastava Dr. Pradip Bhargava Dr. J. Jamdar Dr. S.K. Lunawat

ORTHOPAEDIC JOURNAL OF M. P. CHAPTER

VOLUME 28 | ISSUE 1 | JAN-JUNE 2022

INDEX

Orthopaedics Residency in Post Covid Era

Singh V

Department of Orthopaedics, R.D. Gardi Medical College, Ujjain, (M.P.), India

The COVID-19 pandemic is not only affected medical fields but also has a great influential impact on surgical fields like orthopaedics, as routine outpatient care and elective surgeries were hampered. All routine orthopaedic surgeries were postponed /cancelled because of this pandemic. Orthopaedics practice and training has been changed in post covid era. Orthopaedics residents have faced lot of problems in covid time. Long exhaustive duties and lack of orthopaedics surgery in covid time affected residents. Out of three years of residency almost six to eight months are taken away by covid. They have been trained less in orthopaedics surgery as well as teaching is also got affected in covid era. Residents got less exposure to subspecialities like arthroplasty, arthroscopy and spine. They have worked with physicians in corona wards to fight against COVID along with their routine orthopaedic duties.

In 98% of institutions, academic teaching like seminars, workshops, case presentations, journal club, and ward rounds discussion has stopped during pandemic to prevent overcrowding and to maintain social distancing as many were asymptomatic carriers.

There may be long term consequences, as residency training is crucial period to develop surgical skills and knowledge and if this is not proper, it can affect future orthopaedic practice of candidate.

Due to reduced volume of orthopaedic cases, several departments have adopted a "residency surge plan", with a part of trainees committed to routine hospital duties and remaining quarantined at home or posted in COVID-19-dedicated wards. Disruption of orthopaedic residency routine, usually consisting of surgical training, inpatient and outpatient care, will likely have an enormous impact on resident education. This is particularly relevant when considering that surgical training is practical in nature and is normally delivered in a climate of increasing autonomy, responsibility and complexity. Therefore, preserving orthopaedic education integrity while safeguarding resident health is a priority. Orthopaedics residents have worked very hard in covid period. Their enormous efforts have saved many lives. Though they are not well trained to treat covid patients but their huge efforts helped hospitals to overcome shortage of doctors in covid times. Their teaching and orthopaedics work was affected. Neet pre pg exam postponement increased their first-year residency time to almost 2 years. Now, they are compensating their teaching, academic work, clinical and surgical work. It has affected them physically and mentally.

Small teaching modules, online webinars, offline classes and dissertation teaching are methods which have improved academics and teaching of students. Teachers should also try to show leniency towards their thesis work and exams.

Dr Vivek Singh,
Editor
OJMPC
Department of Orthopaedics, R.D. Gardi Medical College, Ujjain, (M.P.), India

Address of correspondence:
Dr Vivek Singh,
Professor,
Department of Orthopaedics, R.D. Gardi Medical College, Ujjain, (M.P.), India

Email – drviveksingh29@rediffmail.com

How to cite this article:
Singh V. Next Orthopaedics Residency in Post Covid Era. Orthop J MPC. 2022;28(1):1

Available from:
https://ojmpc.com/index.php/ojmpc/article/view/152

Standard care of management in Orthopaedic patient during COVID 19 Pandemic: An Institution based guideline

Macwan A A, Nanda S N, Samant S, Gachhayat A, Patel E, Mohanty A

Study performed at Kalinga Institute of Medical Science Bhubaneswar, Odisha

Abstract

SARS-CoV 2 pandemic has been spread around the world, the developing countries like India with enormous population, the health care system has been exhausted with patients. Social distancing, using three layered face mask, frequent use of sanitization is helpful preventing measure to spread of these deadly virus. There are no clear cut guidelines available in management of Orthopaedic patients till now. The disease and mortality burden will increase eventually without the effective vaccine and medications. With this ongoing pandemic managing elective orthopaedic surgeries and delayed trauma is a challenge. There should be effective protocol to manage emergency cases with optimum care and formulate standard postoperative rehabilitation strategy to deal with the situation. Orthopaedics training is also affected by this pandemic and that should be taken care of with appropriate measures. This article will help the surgeons and hospitals to formulate proper strategies in managing the patients and to face challenges presented in current pandemic situation. It will guide them to re-establish the orthopaedic care and to face future challenges.

Keywords: covid19, orthopedic care, institution guideline, standard care, trauma, hospital care

Address of correspondence
Dr.Anson Albert Macwan
3 rd Year PG Resident
Department Of Orthopaedics
Kalinga Institute of Medical Science
Bhubaneswar, Odisha
Email: ansonmac89@gmail.com

How to site this article
Macwan A A, Nanda S N, Samant S, Gachhayat A, Patel E, Mohanty A. Standard care of management in Orthopaedic patient during COVID 19 Pandemic: An Institution based guideline. Orthop J MPC. 2022;28(1):2-6
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/150

Introduction

Coronavirus disease 2019 (COVID-19) originated in the city of Wuhan in Central China, and has spread quickly worldwide. It causes severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). At present, this newly identified disease is causing a large number of deaths and numerous confirmed cases worldwide and a major life risk to public health[1]. In February 2019 covid 19 was declared as public health emergency of international concern[2]. The cases started emerging from Europe and then to USA and now almost whole world is affected with it. Presently according to WHO, 162 million cases world-wide with 33 million confirmed deaths and around 222 countries are affected[3]. The disease is spreading across the world very quickly and lots of people around the world losing their precious lives.

India is country with population of 1.3 billion, second largest population after china. By the end of July 2019 there were 8 lac cases. Government of India implemented lockdown and compulsory social distancing to fight the disease all over the country to control the disease spread[4]. World Health Organization recommended doctor to population ratio of 1:1,000. India is still lacking adequet infrastructure in health sector in both public and private health sectors to fulfil the healthcare need of its growing population[5], and COVID 19 is putting a huge burden on it. The first case of COVID 19 was reported in india on month of January 2020 in southern state of india.[6] India was quick to response to the spread of COVID 19 compare to other developed countries like United states, Italy, UK. The "Janata Curfew" was implemented by the prime minister of India in month of march with only 360 active cases. It was the world's largest lockdown of 21 days, which failed to

"flatten the curve" and second lockdown was initiated, which further underwent two more extensions. [7] According to the data of health ministry of India on 20 may 2021, the total number of active cases were 26 million with 22 million recoveries. The national recovery rate was 86.74%. Total 20 million tests were done nationwide with mortality rate of 1.11%. Currently India has vaccinated over 180 million citizens.[15]

Standard Orthopaedic practice during pandemic

Orthopaedic patients presenting to casualty and outpatient department during COVID 19 pandemic 1. Infection- septic arthritis and osteomyelitis, 2. trauma, 3. elective OA patients with severe symptoms, 4. severe backpain patients, 5. post-operative follow-up patients, 6. post-operative infected cases, 7. metabolic diseases and bone cancer patients.

Steps to manage orthopaedic patients:-

1. Safety precautions

One of the major hurdle is to segregate COVID 19 infected patients from non-infected patients, doctors as well as staff. To create a safe environment, the patients who are arriving to casualty need to be kept in separate cubicle. Every patient entering the hospital need to be scanned by thermal body temperature check and should be sanitised with hand sanitizer. All patient entering to the hospital should be mandated to wear a mask, preferably 3 layered mask or N95 mask. Attenders accompanying the patients need to be restricted to one attender per person. All the doctors and staff working with patient must be ensure that they are asymptomatic and should be under go regular testing for COVID 19 RTPCR. The examination areas has to be cleaned frequently with 2% chlorhexidine or 1% hypochlorite solution including tables, stools, doors and door knobs.

2. Examination in emergency room

Doctors and staffs working in casualty need to be equipped with a N95 mask, face shield, hand sanitizers and a pair of gloves. All the patients arriving in the casualty with orthopaedic complaint are mandated to wear compulsory mask during history taking and physical examination. A detailed history of contact with COVID patient and sign and symptoms of COVID infection should be checked in all patients before examination. Compulsory use of PPE by health care provider in emergency department is one of the major protective measures to decrease the spread. All the patients who require admission should undergo screening test of RAPID COVID 19 test and are shifted to isolation ward with a negative report. Those patients are again tested for COVID 19 RTPCR, which takes 24hours on an average. After obtaining a negative RTPCR report, the patients are shifted to Orthopaedic ward and are managed accordingly. The patients with positive COVID report (either ANTIGEN or RTPCR) are directed to COVID hospital and managed accordingly.

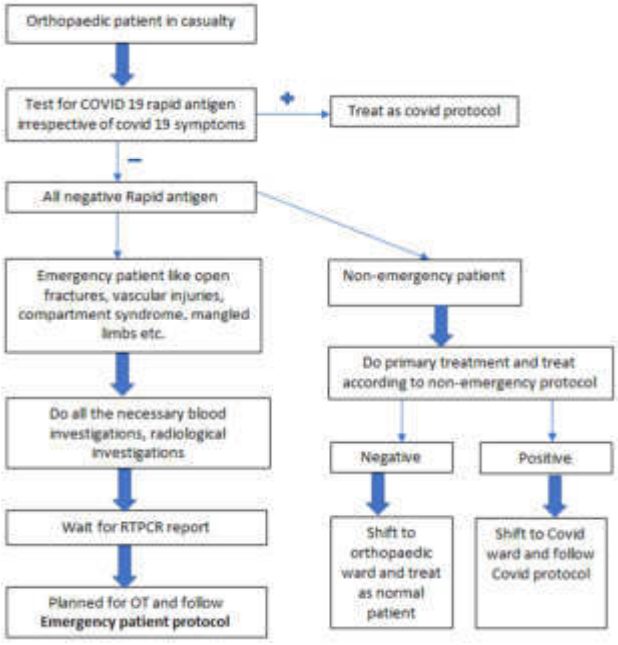
3. Treatment of OPD and elective patients

All the patients arriving to OPD must be symptom free and need to be checked for temperature. Mask need to be made compulsory for all individuals in OPD area. All the doctors and paramedical staffs should have a face shield. All health care provider should be instructed to follow social distancing and to use hand-sanitizer frequently also to use disposable gloves. All follow up post-operative patients should be segregated and are examined in a single room and instructed for home care if possible to avoid frequent visit. All the elective patients with severe symptoms are examined and documented for their symptoms. Patients with low back pain, avascular necrosis, ankylosing hip, osteoarthritis and rheumatoid arthritis should be prescribed an adequate analgesia to delay and sort of surgical intervention. Bone tumour patients with pathological fracture, infection requiring admission should be investigated with all the routine tests, pre anaesthetic check-up, necessary consultation before operation. Proper history regarding COVID 19 contact, any sign and symptoms and symptomatic people in his family should be documented. RTPCR for COVID 19 for both patient and attendant must be done before admission. All the patient must be educated and stimulated for TELE-Medicine and to use electronic media for queries and follow ups.

4. Management of trauma cases

Upon arriving the patient at the emergency room, the triage assessment must be done and all the closed fracture patients should be treated with primary splint and to be tested for COVID 19 rapid antigen. Then, as per protocol they are admitted in Isolation ward. Patients are further tested for RTPCR before definitive management.

Flow charts for managing patients during pandemic (Fig 1)



All the open fractures, compartment syndrome and suspected vascular injury patients are tested for COVID 19 rapid antigen and all negative patients need to be planned for emergency OT with PPE and all required protection. All the positive patients are shifted to COVID hospital. There should be arrangement of emergency OT in COVID hospital and those COVID positive patients who need any emergency procedure should be managed. Patients requiring fir ICU support should be managed in either COVID ICU or normal ICU as per the COVID report.

Discussion

COVID 19 has spread to whole world and has saturated the health care system. As so many COVID 19 patients falling sick in very short period of time, the demand of hospital admission are increasing, as well as demand for physicians to treat them has also increased. Along with it increases the demand of PPE Kits, ventilators, ICU care and trained health care workers. Since the beginning of the pandemic there is decrease in the number of orthopaedic patients. There is significant decrease in number of patients coming to OPD, IPD admission, elective surgeries and number of total surgeries. Number of patients presenting to emergency department has also decreased due to lockdown and lless number of RTAs.[12]

The decrease in amount of orthopaedic surgeries was seen around the world. There was 44% reduction in surgeries and decease in orthopaedic intervention in upper limb. Lower limb fractures and also replacement surgeries.[12] However there was increased in number mortality in proximal femoral fractures in elderly age group. Patralekh et all have done a systematic review in 4355 patients with proximal femoral fractures and reported increased mortality in COVID 19 positive patients and the reason was shown to cytokine storm post operatively[13]

The recent COVID 19 pandemic is expected to continue for coming years. However high patient load compare to healthcare infrastructure is always challenging in India. Since there is decreased in number of elective orthopaedic procedures and musculoskeletal tumour patients. It will eventually lead to increase in orthopaedic related disease burden and also increase in mortality rate. Patients who are RTPCR positive and can be managed conservatively should be treated accordingly with all the precautions taken into consideration, however patient requiring surgeries should wait until asymptomatic and for RTPCR test to become negative. However, we should keep eye on the analgesia, immobilization and neurovascular status time to time.

As the disease spread across the world, the hospitals became of the important zones for treatment and also the potential zones of community transmission. The big issue was how to restart the typical orthopaedic care in middle of pandemic, as it was not only the issue of safety but also as an issue in ethical point of view.[8] The American College of Surgeons (ACS) and the Centers for Medicare

& Medicaid Services (CMS) issued guidelines for elective surgeries . However, the surgeons had difficulties in identifying the elective procedures as there are no clear guidelines and it resulted in confusion[8]. Cancelation of all elective procedures created tremendous backlog of patients[9]. It is a worldwide challenge to resume the elective procedures during this COVID 19 pandemic. As we know the various stages of epidemic crisis, it is advisable to minimize and differ all the elective surgeries[10]. However, the system has to be prepared for gradually restarting of the operative procedures with proper safety of the doctors as well as medical staff in the hospital by the time we reach to normal. As the prevalence of the disease is still high, with limited staff and increasing number of cases which is pressurizing the healthcare system, hospital should act fast and start the essential orthopaedic surgical care while protecting the patient and valuable resources[11]

Orthopaedic care also need to be resumed as before pandemic, with some changes in treatment protocols and follow-up of the patients. Resuming of the orthopaedic practice should be slow, systematic and strategic. Orthopaedic patients presenting to casualty following trauma due to RTA, fall from standing height in elderly, polytrauma patients, vascular injury patients were managed with proper treatment protocols till the COVID 19 pandemic ends. Patients who are admitted, operated and discharged should try to decrease the infection spread and try to keep themselves safe and healthy. With no clear cut guidelines available for the treatment of the orthopaedic patients, it is difficult to manage them in some part of the country where there are very limited resources available. As now various effective vaccinations available, we urge the entire patient coming to us get vaccinated and still mandate to follow certain protocols for the smooth work of the orthopaedic care without harming the patient as well as healthcare workers.

Medical education has been always suffered during pandemics. All the medical institutions were shut down following COVID 19 pandemic to decrease the transmission. The classroom teaching has been shifted to online platforms but the practical teaching including patient centred learning is affected significantly. Academic is severly affected for orthopaedics residents, due to decrease in number of patients as well as number of surgeries. On the other hand, they have to join in the battle against COVID 19 along with other physicians in various COVID hospitals. More stress should be given to improvise and strengthen the online training programme which can able to provide similar training environment like that of physical training programme. The senior post graduates should get more opportunities during this pandemic to get adequate training which can help them in getting employment in future.[14]

Conclusion

Resuming of orthopaedic practice should be safe and strategic for patient care as well as safety of the health care workers. Elective surgeries should be avoided and conservative management should be considered if no superior outcome can be achieved with surgery. Operative time should be minimized as much as possible with minimal surgical interventions. Hospitals and surgeons should follow the advised guideline by national or state health authorities. Medical education also needs to be continued using different online platforms. With proper planning and using effective protocols we can help Developing Countries and rest of the world for going back to new normal by modifying the standard treatment. Preventive measures should be taken to preserve infrastructure and manpower to manage ongoing pandemic.

References

1. Li H, Liu SM, Yu XH, Tang SL, Tang CK. Coronavirus disease 2019 (COVID-19): current status and future perspectives. Int J Antimicrob Agents. 2020;55(5):105951. doi:10.1016/j.ijantimicag.2020.105951
2. World Health Organization. Statement on the Second Meeting of the International Health Regulations. Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). 2005. https ://www.who.int/news-room/detai l/30-01-2020-state menton- the-secon dmeet

ing-of-the-inter natio nal-healt h-regul ation s-(2005)-emerg ency-commi ttee-regar ding-the-outbr eak-of-novel coron aviru s-(2019-ncov). Accessed 17 Feb 2020.
3. Coronavirus disease (COVID-19)/https://www.who.int/emergencies/diseases/novel-coronavirus-2019/World Health Organization/December 07, 2020
4. Ghosh A, Nundy S, Mallick TK. How India is dealing with COVID-19 pandemic. Sensors International. 2020;1:100021. doi:10.1016/j.sintl.2020.100021
5. Kumar R, Pal R. India achieves WHO recommended doctor population ratio: A call for paradigm shift in public health discourse!. J Family Med Prim Care. 2018;7(5):841-844. doi:10.4103/jfmpc.jfmpc_218_18
6. Ministry of Health and Family Welfare/https://www.mohfw.gov.in/MoHFW
7. Venkata-Subramani M, Roman J. The Coronavirus Response in India - World's Largest Lockdown. Am J Med Sci. 2020;360(6):742-748. doi:10.1016/j.amjms.2020.08.002
8. Humbyrd CJ, Dunham AM, Xu AL, Rieder TN. Restarting Orthopaedic Care in a Pandemic: Ethical Framework and Case Examples. J Am Acad Orthop Surg. 2020 Nov 2. doi: 10.5435/JAAOS-D-20-00871. Epub ahead of print. PMID: 33156215.
9. CovidSurg Collaborative, Nepogodiev D, Bhangu A (2020) Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. Br J Surg 12. 10.1002/bjs.11746.
10. Tuech JJ, Gangloff A, Schwarz L (2020) Our challenge is to adapt the organization of our system to the six stages of the epidemic to go beyond the COVID-19 crisis. Br J Surg. 10.1002/bjs.11639
11. Neradi D, Hooda A, Shetty A, Kumar D, Salaria AK, Goni V. Management of Orthopaedic Patients During COVID-19 Pandemic in India: A Guide. Indian J Orthop. 2020;54(3):402-407. Published 2020 Apr 27. doi:10.1007/s43465-020-00122-6
12. Kumar, S., Shah, B., Johari, A. et al. Covid-19 Pandemic: Resumption of Orthopedic Care and Medical Education. JOIO 55, 506–515 (2021). https://doi.org/10.1007/s43465-021-00379-5
13. Mohit Kumar Patralekh, Vijay Kumar Jain, Karthikeyan P. Iyengar, Gaurav Kumar Upadhyaya, Raju Vaishya,Mortality escalates in patients of proximal femoral fractures with COVID-19: A systematic review and meta-analysis of 35 studies on 4255 patients, Journal of Clinical Orthopaedics and Trauma,Volume 18,2021,Pages 80-93, https://doi.org/10.1016/j.jcot.2021.03.023.
14. Macdougall, C., Dangerfeld, P., Katz, D., & Strain, W. (2020). The impact of COVID-19 on Medical education and Medical Students. How and when can they return to placements? MedEdPublish, 9(1), 159. https://doi.org/10.15694/mep.2020.000159.1. https://pib.gov.in/PressReleasePage.aspx?PRID=1720166

Primary cemented bipolar hemiarthroplasty in elderly unstable intertrochanteric fractures.

Thora A., Maurya A.

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

Abstract

Background: The incidence of inter-trochanteric fractures of the femur is very high in the elderly population. (1) Anatomic restoration of the neck of femur, along with articular congruity is the goal of management.

Materials and Methods: Thirty patients with unstable Intertrochanteric fractures were operated by Bipolar Hemiarthroplasty. Follow-ups were taken at 2, 6, 10 and 16 weeks. Harris Hip Score and FIM score were assessed.

Results: Mean Harris Hip score achieved was 87 at 16 weeks and Mean FIM score achieved was 78.9 at 16 weeks indicating good functional outcomes. The outcome was excellent in 23.4%, Good in 63.3%, Fair in 10% and Poor in 3.3% as per HHS.

Conclusion: This procedure offered pain free mobile hip with early mobilization, easy rehabilitation and early return to functional level, when standard techniques were used.

Keywords: Harris Hip Score, FIM Score, Bipolar Hemiarthroplasty, Intertrochanteric Femur Fracture

Address of correspondence;
Dr Ankit Thora
Department of Orthopaedics, MGM Medical College, Indore.

How to cite this article:
Thora A, Maurya A, Primary cemented bipolar hemiarthroplasty in elderly unstable intertrochanteric fractures. Orthop J MPC. 2022;28(1):7-11
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/143

Introduction

The world-wide incidence of all hip fractures is around 402 per 100000 and the incidence of Intertrochanteric fracture is estimated to be around 171 per 100000 in 2019.(2) The annual incidence of hip fractures across Indian population can be estimated roughly as 61,083 men and 81,724 women above the age of 50 years. (3). The incidence is roughly the same as intra-capsular femoral neck fractures. The female: male ratio is between 2:1 and 8:1. Stable intertrochanteric fracture can be easily treated by osteosynthesis with predictable good result (4,5), whereas the management of unstable intertrochanteric fracture are challenging because of poor bone quality, loss of reduction and prolonged protected weight bearing(6,7).

In past fixed angle devices were used for fixation of these fractures, but complication like implant cut out and fracture displacement were seen(8,9) Subsequently, sliding hip screw fixation was used with much success and became prominent method of fixation of these fractures (10,11) but complications such as head perforation, excessive sliding with subsequent shortening, plate pull out and plate breakage continued to be the problem particularly with the unstable type fractures (12,13).

Intramedullary interlocking devices have shown reduced tendency for cut out in osteoporotic bone(14) and also better results in case of unstable intertrochanteric fractures(15,16). The duration of surgery is less minimising blood loss. The procedure may sometimes result in screw cut out or loss of reduction in osteoporotic patients. Management of such cases with primary cemented bipolar hemiarthroplasty permits early mobilization and thus avoiding most

complication related to fixation and prolonged immobilization (17).

Materials and Methods

This study was conducted on 30 cases with unstable intertrochanteric femur fracture above 60 years of age, treated at our Centre. All the patients with neglected injury, pathological fracture or other associated injuries, psychiatric disorders, neurological disorders were excluded. All Patients were assessed for associated injuries and primarily stabilized with fluids and analgesics. Standard AP and Lateral hip radiographs were done and ankle traction applied.

Prior to study institutional review board approval was obtained and well-informed consents were taken and bipolar Hemiarthroplasty was planned. Patient taken for OT under all aseptic precautions and suitable anesthesia (Spinal Anesthesia or GA) and operated in lateral position with affected limb above. All the patients were operated using standard posterior approach to the hip.

Femoral head was removed and a neck cut is taken roughly about 1-2 cm above lesser trochanter (LT) depending upon the amount of comminution. In case of greater trochanter (GT) fractures, the gluteus medius, GT and the vastus lateralis apparatus were maintained in continuity as a stable lateral support which was fixed loosely to shaft fragment with ethibond sutures or Stainless Steel (SS) wires. The Femoral Canal was broached in appropriate ante-version.

A bipolar prosthesis was then inserted and trial reduction was done and with the trial prosthesis in situ traction was applied to the leg to compare it with the opposite leg for any Limb Length Discrepancy (LLD). After confirming the leg length the implant was inserted into the femur and prosthesis was reduced. Traction was then applied with implant in situ to achieve the desired limb length by comparing with the opposite limb on table.

Applied traction caused femur to be pulled distally to note the amount of distraction between the prosthesis and the femoral cut so as to mark the level on the prosthesis. This gave an idea of how much the femur implant should sink into the proximal femur so as to achieve the desired limb length at the time of final cementing of the implant.

During the final fixation of the stem, the cemented stem was allowed to sink in the femoral canal up to the mark made on the prosthesis in above stated manner and for the remaining portion a cement mantle was made so that the final limb length was equalized. Once the prosthesis was fixed, the broken trochanter and the calcar were also fixed using Ethibond sutures or SS wires or tension band wiring (if required). The sleeve of Gluteus medius, GT and vastus lateralis if reconstructed was now reattached to the shaft by additional wires.

The short external rotators were then re-sutured using bone tunnels in GT with the closure of the superficial layers, as routine over a suction drain after achieving hemostasis. Standard precautions of hip hemiarthroplasty were followed. Post-operative intravenous antibiotic was given for 3 days. Oral analgesics and antibiotics were given for 5 days.

All patients underwent a routine postoperative physiotherapy protocol that included early gait training in form of walking with the help of a walker which was started second day post-surgery. Patients were followed up at 2week, 6 weeks, 10 weeks and 16 weeks for functional outcome assessment using HHS and FIM score. Suture Removal was done at 2weeks. Case 1- 65 years old female with Left side fracture intertrochanteric femur (Evans Type V)

Results

Results-In our study of 30 patients (15 Males & 15Females) with unstable Intertrochanteric femur fracture, the mean age found was 76 years (range - 61 years to 90 years) with right side preponderance.

The mean operative time of 90 minutes with average duration of hospital stay being 7.8 days and average blood loss being 247 ml. The most common comorbidities the patient had were Hypertension and Diabetes Mellitus which led to delay in their surgery. Most

common type of Intertrochanteric Fracture was Evans Grade IV.

Figure 1- Preop x-ray

Figure-2- Post op xray

Figure 3- 2.5 months post op xray

The mean Harris Hip Score at 2 weeks postoperative was 62 ± 2.09, and at 4 months it was 87± 4.19. The mean FIM score at 2 weeks postoperatively was 44 and at 4months it was 78.9.

Mean HHS was excellent for 7 patients (23.4%), good for 19 patients (63.3%), fair for 3 patients (10%) and poor for 1 patient (3.3%).

Figure 4- 4 moths post op xray

Figure 5- walking with walker

Figure 5- walking independently

Major complications associated with the procedure were superficial infection in 1 patient (3.3%) and Joint Dislocation in 1 patient (3.3%).

Discussion

In our study around 86% patients had good to excellent results of hemiarthroplasty in management of unstable intertrochanteric fractures. **Sanchetti et al** reported 71% of

good to excellent results according to HHS in their series of 35 patients treated with hemiarthroplasty(18). **Rodop et al**, in a study of 37 intertrochanteric fractures treated with bipolar hemiarthroplasty achieved 82% of good to excellent results as assessed by HHS (19).

In our study, at 4 months of follow up, we encountered 1 case of superficial infection (which responded to analgesics and antibiotics) and one case of dislocation which was managed with girdlestone arthroplasty subsequently. **Grimsurd et al**, in a study of 39 patients of unstable intertrochanteric fractures treated with cemented bipolar hemiarthroplasty, reported a relatively low rate of complication (20). **Stern et al**, used Leinbach prosthesis for treatment of 22 intertrochanteric factures and found early ambulation and early return to preinjury status as a definitive advantage (21).

In our study average blood loss was 334 ml and average operative time was 90 minutes. **Sanchetti et al** reported average blood loss of 350 ml and operative time of 71 minutes (19).

Conclusion

In this study we come to conclusion that, primary cemented hemiarthroplasty in intertrochanteric femur fractures offered pain free mobile hip with early mobilization, easy rehabilitation and early return to functional level, when standard techniques were used. Bipolar hemiarthroplasty reduced the complications related to prolonged immobilization, need for prolong rehabilitation, residual deformities and need for revision surgeries. The procedure offered faster mobilization, rapid return to preinjury level, improve the quality of life and gave long term solution in elderly patients with unstable intertrochanteric fracture of femur. Functional outcomes in our study were at par with other implants like DHS or PFN with much less complications and early immobilization in geriatric age group patients. From above findings

we conclude that, Primary Cemented Bipolar Hemiarthroplasty can be used as a preferred method of treatment of unstable intertrochanteric femur fractures in elderly age group patients.

References

1. Kannus P, Parkkari J, Sievδnen H, Heinonen A, Vuori I, Jδrvinen M. Epidemiology of hip fractures. Bone. 1996;18:57S–63.
2. Adeyemi, Ayoade PhD, Delhougne, Gary MS, Incidence and Economic Burden of intertrochanteric Fracture, JBJS (OA) March28,2019 volume4 – Issue 1 p e0045
3. D. K. Dhanwal,1 R. Siwach,3 V. Dixit,1 A. Mithal,2 K. Jameson,4 and C. Cooper4, Arch Osteoporos. Incidence of hip fracture in Rohtak district, North India, Author manuscript PMC 2013 Dec; 8(0): 135. doi:10.1007/s11657-013-0135-2
4. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, et al., Fracture and dislocation classification compendium: TraumaAssociation classification, database and outcomes committee. JOrthop Trauma. 2007;21:S1-133.
5. Larsson S. Treatment of osteoporotic fractures. Scand J Surg.2002:91:140-146.
6. Bannister GC, Gibson AG, Ackroyd CE, Newman JH. The fixation and prognosis of trochanteric fractures: A randomized prospectivecontrolled trial. Clinical Orthop Relat Res. 1990;254:242-6.
7. Chinoy MA, Parker M). Fixed nail plates, versus sliding hipsystems for the treatment of trochanteric femoral fractures: A metaanalysis of 14 studies. Injury 1999;30:157-63.
8. Flores LA, Harrington II. Martin H. The stability ofintertrochanteric fractures treated with a sliding screw plate. J BoneJoint Surgery Br. 1990:72:37-40
9. Sernbo 1, Fredin H. Changing methods of hip fractureosteosynthesis in Sweden: An epidemiological enquiry covering46,900cases. Acta Orthop Scand. 1993;64:173-4.
10. Larsson S, Friberg S, Hansson LI. Trochanteric fractures: Mobility,complications, and mortality in 607 cases treated with the sliding-screw plate. Clin Orthop Relat Res. 1990;260:232–41.

11. Bess RJ, Jolly SA. Comparison of compression hip screw and gamma nail for treatment of peritrochanteric fractures. J SouthOrthop Assoc. 1997;6:173-9.
12. Kim WY, Han CH, Park J, Kim JY. Failure of intertrochantericfracture fixation with a dynamic hip screw in relation topreoperative fractures ability and osteoporosis. Intra op.2001;25:360-2.
13. Jensen JS, Tondevold E, Mossing N. Unstable trochantericfractures treatedthe sliding screw-plate system:biomechanical study of unstable trochanteric fractures. III, ActaOrtho Scand. 1978;49:392-7.
14. Halder SC. The Gamma nail for peritrochanteric fractures. J BoneJoint Surg: A Br. 1992;74:340–4.
15. Davis TR, Sher JL, Horsman A, Simpson M, Porter BB, ChekettsRG. Intertrochanteric femoral fractures: Mechanical failure afterinternal fixation. J Bone Joint Surg Br 1990;72:26-31
16. Thomas AP. Dynamic hip screws that fail, Injury. 1991;22:45-46.
17. Silverton CD, Jacobs JJ, Rosenberg AG, Kull L, Conley A, Galante JO. Complications of a cable grip system. J Arthroplasty. 1996;11:400–404.
18. KH Sancheti, PK Sancheti, AK Shyam, S Patil, Q Dhariwal, and R Joshi, Indian J Orthop. 2010 Oct-Dec; 44(4): 428–434.PMCID: PMC2947731,PMID: 20924485, Primary hemiarthroplasty for unstable osteoporotic intertrochanteric fractures in the elderly: A retrospective case series,
19. Rodop O, Kiral A, Kaplan H, Akmaz I. Primary bipolar hemiprosthesis for unstable intertrochanteric fractures. Int Orthop. 2002;26:233–7.
20. Grimsrud C, Monzon RJ, Richman J, Ries MD. Cemented hip arthroplasty with a novel cierclage cable technique for unstable intertrochanteric hip fractures. J Arthroplast. 2005;20:337–43.
21. Stern MB, Goldstein TB. The use of the Leinbach prosthesis in intertrochanteric fractures of the hip. Clin Orthop Relat Res 1977; 128:325-331

Functional and radiological outcome of parallel plate technique in distal humerus fractures: a prospective study

Singh V, Bhinde S, Patidar A, Agrawal A, Sharma S K

Study performed at Department of Orthopaedics, R. D. Gardi Medical College & C. R. G. Hospital & Associated Charitable Hospital, Ujjain (M.P.)

Abstract

Background: Distal humerus fractures account for 2-6% of all fractures and 30% of all elbow fractures.These are difficult to treat because of their complex anatomy, metaphyseal comminution of fracture, subchondral bone and articular involvement with small fragments.

Aim: To study the results of intercondylar fracture distal end humerus treated with open reduction internal fixation with parallel plating technique in terms of final range of motion of elbow, union time and rate of complications.

Material and Methods: A total of 25 patients with distal humerus intercondylar fractures treated with parallel plating technique were included in this prospective randomised study. At each follow up patients were evaluated clinically and radiologically for union and outcomes were measured in terms of MAYO Elbow Performance Score(MEPS) consisting of pain intensity, range of motion, stability and function.

Results: Eight (32%) patients got excellent outcome, fourteen(56%) got good outcome and 3(12%) got poor outcomes and complications observed were infection, non union, hardware prominence and elbow stiffness.

Conclusion: Open reduction internal fixation(ORIF) with parallel plating technique can be a successful technique for fixation of distal humerus intercondylar fractures when its principles are strictly adhered to.

Keywords: Distal humerus fractures, parallel plating, MEPS score.

Address of correspondence
Dr Vivek Singh
Professor & Unit head, Department of Orthopaedics, R. D. Gardi Medical College, Ujjain
Email-
drviveksingh29@rediffmail.com

How to site this article
Singh V, Bhinde S, Patidar A, Jain S, Sharma SK
Functional and radiological outcome of parallel plate technique in distal humerus fractures: a prospective study Orthop J MPC. 2022;28(1):12-17
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/153

Introduction

Distal humerus intraarticular fractures are relatively uncommon and comprise approximately 2 to 6% of all the fractures and 1/3rd of all humeral fractures (1). In this modern society with a growing elderly population and extremely active young population, incidences of distal humerus fractures have increased and have a bimodal age distribution. High energy injuries like Road Traffic Accidents (RTA) and side swipe injuries are common in younger patients, while low energy injuries like a simple fall or trivial trauma are more prevalent in elderly patients with osteoporosis.

These are the fractures which occur within a square of lower end humerus, whose base is the distance between epicondyles, on an antero posterior radiograph. The treatment of these fractures is complex due to their proximity to vital structures, metaphyseal comminution in the fracture, complex anatomic injury patterns with articular involvement of small fragments, limited

subchondral bone and therefore limited space for instrumentation (3).

Poor outcomes like contracture secondary to prolonged immobilisation thought to be necessary to protect the fixation, on union, high failure rate is also noted with old internal fixation techniques. The chances of functional impairment and deformity are very high following conservative treatment of distal humerus fractures, and hence they are deemed unacceptable for modern practice and they are operated upon to meet the AO principles.

The recent trend for managing these fractures is by open reduction and internal fixation and stable osteosynthesis, with early rehabilitation as immobilization may lead to stiffness of the elbow joint (3). The goal of restoring a painless and functional elbow, in a fractured distal humerus, requires anatomical re-construction and stable fixation. The distal humerus consists of an articular block, connected to the shaft with two pillars (medial and lateral pillar). The main principle of managing these fractures is re-construction of the articular block and stable internal fixation of this re-constructed block with the shaft by plating on both pillars.(4) Without this dual plate arrangement, stability of fixation can be inadequate and this has been proven beyond doubt .(5)

Many studies have validated the superiority of double plating technique which consists of two major configurations, the orthogonal/ perpendicular/ 90-90degree plating and the parallel plating.(6) The orthogonal plating is performed by placing one plate medially and one posterolaterally and the parallel plate by one medially and the other laterally.(7) In order to obtain a more stable initial fixation, parallel (180°) plating has been introduced with the concept that the screws will interdigitate with the distal fracture fragments and restore the 'tie beam arch' of the distal humerus. Biomechanical comparison studies concluded that parallel system under physiological loads provided significantly higher stability in terms of stiffness, as well as a tendency for higher stiffness under torsion (8).

Materials and methods

25 cases of distal humerus fractures admitted and operated with bicolumnar parallel plate technique between August 2019 to July 2021 for the period of 2 years were included in our study. All the patients of distal humerus fractures with >18 years of age with medical fitness for surgery with closed fractures, Grade 1 and Grade 2 compound injuries and AO type A2, A3 and C injuries were included in the study. Patients medically unfit for surgery, those not willing for surgery, patients with neurovascular injuries and Grade 3 compound open fractures were not included in the study. All the necessary pre-operative work up was done in the form of radiological and hematological investigations. Well written informed consent was taken from all the patients enrolled in the study. Prior Ethics Committee approval was obtained. MAYO Elbow Performance Score (MEPS) was calculated.

A detailed history regarding name, age, sex, date of injury, mechanism of injury, residential address, occupational status and associated injuries were recorded. Patients general condition, vitals were noted. Patients affected limb were x rayed in both true antero-posterior and true lateral views in slight traction after removing slab if applied previously. The patients were submitted to a battery of routine investigations such as CBC, electrolytes, urea creatinine ratio, viral markers and Covid 19 –RTPCR test required for pre-anesthetic checkup. Associated medical comorbidities were dealt with if present.

Our aim was to achieve eight technical principles based on two goals:(1) Maximizing fixation in the distal fragments. (2) Ensuring that all fixation in the distal segment contributes to stability at the supracondylar level. Once the fracture was exposed the articular reduction of the fracture fragment was carried out by anatomical reduction of the distal articular fragments with temporary K-wires and bone clamp in a way that the wires do not interfere in plate placement. Plate placement and provisional fixation with Pre - bended 3.5mm plates were placed in the medial and lateral ridges in a way that both end up at different levels at the humeral shaft.

Both the plates were fixed with at least 3 screws in the shaft. A (first proximal) screw was placed in each plate but not fully tightened to allow movement of the plate for later compression. Distal fragment was fixed with temporary K wires. Long screws were applied in the medial and lateral distal fragments for articular fixation. Supra condylar compression was achieved by backing out the proximal screw on one side and application of a large bone clamp distally on that side and proximally on the opposite cortex to eccentrically load the supracondylar region. A second proximal screw was inserted through the plate in compression mode, and then the backed-out screw was retightened. This step was repeated for other column also. Diaphyseal screws were to be applied to achieve residual compression through under contoured plates. Temporary K wires in the distal fragments were removed and replaced with screws and thus, final fixation was achieved. After final fixation of the fracture fragments and osteotomized olecranon was fixed with a Tension Band Wire (TBW). A suction drain was attached and closure was done in layers.

Post operatively, patients were placed in a well padded above elbow extension splint and limb was kept elevated for first 3 post op days. Active range of motion and finger movements were started from day 1. Intravenous antibiotics were given for 5 days; Oral antibiotics were given for 6 days. Drain removal after 48 hours. Suture removal done on 13th post op day. Elbow range of motion exercises were performed from day 3 onwards as patient tolerated. Generally, active-assisted and active range of motion exercises were encouraged (flexion, pronation, and supination) of elbow. Patients were allowed to return to their normal routine activities after 6 months. Follow up at 2nd, 6th, 12th, and 24th week. Patients were evaluated clinically and radiologically for union at each follow up, and the outcomes were measured in terms of Mayo elbow performance score (MEPS).

Results

Maximum numbers of patient in this study were of middle-aged group and the mean age was 45.24 years. Incidence was more in females (56%) as compared to males (44%). Incidence was slightly more on right side (52%) as compared to left side (48%). Most common mode of trauma was Motor Vehicle Accident (44%) followed by fall from height (36%). Associated injuries were encountered in 7 cases (28%). Fracture distal end radius was the most common associated injury encountered (8%).

Fig.1 articular reduction of fragments with provisional K-wires.

Fig.2-Plates placed in medial and lateral columns of distal humerus.

Fig.3 – Final construct with TBW of the osteomised olecranon.

Fig.4- Pre-operative radiograph

Fig.5- Immediate post-operative radiograph

Fig.6- 24weekspost operative clinical

Mean trauma and surgery time interval was 6.64 days. Mean duration of surgery was 111 minutes. Mean blood loss was 49.2 ml. The most common approach used was olecranon osteotomy (76%), followed by triceps reflecting anconeus pedicle-TRAP approach (16%) and para-tricipital approach (8%). The range of movements that is flexion, extension, supination, pronation was good to excellent in majority of cases. Average time of union was about 13.6 weeks. 14 patients had good, 8 patients had excellent and 3 patients had poor MEPS scores at final follow up. 76% of patients had nil complications. 12% complained of elbow stiffness. 8% complained of superficial wound infection. 4% complained of hardware prominence.

Discussion

A well-functioning elbow is a prerequisite for performing day to day activities of daily living. Intercondylar humerus fractures directly affect the mobility and stability of the elbow joint and hinder the functional capacity of the elbow, thus affecting the person economically and socially. Ulnohumeral joint and radiohumeral joint relationship should be perfect to achieve a better functional outcome. Open reduction and internal fixation with parallel plate technique has provided a good functional outcome for distal humerus fractures management.

The mean age of our study group was 45.24 years. It was seen from our study that mean age for distal humerus fractures is on the comparative decline as more and more younger age group patients are involved now, especially in a developing country like India. This can be attributed to the rise of Motor Vehicle Accidents amongst the young. The age range for our study was 19-71 years. Sanchez Sotello (2) had a mean age range 16-91 years, Sanders et al (12) had a mean age range of 12-85 years, whereas, Gofton et al (13) had an age range of 16-80 years. More females were affected in our study group as compared to males and the male female ratio (M: F) of our group was 1:1.2, which was discordant with other study groups. Majority of patients suffering from distal humerus fractures arrived at our centres as they were part of motor vehicle injuries (44%). This was followed by fall from height (36%). The results of our study were not concordant with study of Sanchez Sotello (2) where the major mode of injury was fall from height (56%). Our results suggested that motor vehicle accidents are on the rise as more and more young population are travelling in roads now a days and are parts of rash driving. Fracture configuration according to AO type was significantly associated with functional outcomes in our study group. Majority of our patients suffered from AO type C1 injury (40%) followed by AO type C2 injury (28%). Group C had poor MEPS scores than Group A patients which suggested direct association between fracture configuration and functional results. Since Group C fractures are more common than Group A fractures, it complements the fact that high velocity motor vehicle injuries are more prevalent these days. In our study group, average time of union was 13.28 weeks, with a range between 10 weeks and 18 weeks, which was in concordance with the other study groups. This is the radiological outcome of our study. Time of union had a significantly positive relation with the AO classification of fracture with a p value of 0.021. According to the MEPS grading criteria, we obtained excellent results in 32%, good results in 56% and poor results in 12% of our cases, with a mean MEPS score of 82.2. It was in concordance with other study groups. This suggested parallel plating technique for distal

humerus fractures provided good to excellent functional outcomes in the majority of cases. Complications rates of 24% was observed in our study which was divided into-elbow stiffness in 12%, superficial wound infection in 8% and hardware prominence in 4%. Patients who developed superficial wound infection were treated conservatively with antibiotics. Elbow stiffness was resolved with aggressive physiotherapy. Sanchez Sotello et al(2) encountered complication rates of 43% which was divided into- heterotopic ossification in 16%, ulnar neuropathy in 6%, superficial infection in 6%, posttraumatic arthritis in 6% non union , deep infections and osteonecrosis in 3%, which was not in concordance with our study results. The rates of infection, elbow stiffness and heterotopic ossifications were higher in type B and C fractures as compared to type A fractures as seen in a study conducted by Robinson et al. (14)

Table 1- Comparing our study with other study groups

Studies	Mean age in years	Complication Rates	Average time of fracture union (weeks)	MAYO Elbow Performance Score(MEPS)	Number of patients	M:F ratio
Sanchez Sotello et al(2)	58	43%	12	85	32	1.4:1
Atalar et al(9)	47	48%	Not specified	86.1±12.6	37	1.6:1
Athwal et al(10)	52	53%	12.8	84	21	2:1
Dinesh S et al(11)	39	41%	13.4	82	24	2:1
Present study	45.24	24%	13.28	82.2	25	1.2:1

Conclusion-Distal humerus fractures continue to be a complex fracture for surgeons to treat. Open reduction and internal fixation is the treatment of choice for distal humerus fractures. Anatomical reduction, stable fixation and early elbow mobilisation are the prerequisites for better functional outcome.

Parallel plating technique provides greater stability in osteoporotic bones and highly complex comminuted fractures as compared to other traditional plates used for the same. Parallel plating may be the preferred technique utilised for very distal fracture patterns since more stability can be obtained by placing additional screws in the distal fragment. Therefore, parallel plating can be a successful technique for internal fixation of distal humerus when its principles are strictly adhered to.

References:

1. Kulkarni, V., Mahesh, U., Jumani, M. S., Shivalingaiah, K., YS, H., & Qureshi, A. (2017). To study the outcome of intercondylar fractures of distal humerus using dual plating and its functional outcome. International Journal of Orthopaedics, 3(4), 565-570.
2. Sanchez-Sotelo, J., Torchia, M. E., & O'Driscoll, S. W. (2007). Complex distal humeral fractures: internal fixation with a principle-based parallel-plate technique. JBJS, 89(5), 961-969.
3. McKee, M. D., Wilson, T. L., Winston, L., Schemitsch, E. H., & Richards, R. R. (2000). Functional outcome following surgical treatment of intra-articular distal humeral fractures through a posterior approach. JBJS, 82(12), 1701.
4. Principle-based internal fixation of distal humerus fractures. Sanchez-Sotelo J, Torchia ME, O'driscoll SWTech Hand Up Extrem Surg. 2001 Dec; 5(4):179-87.
5. Fractures of the distal humerus. Ring D, Jupiter JB Orthop Clin North Am. 2000 Jan; 31(1):103-13.
6. Surgical fixation of intra-articular fractures of the distal humerus in adults. Soon JL, Chan BK, Low CO Injury. 2004 Jan; 35(1):44-54. Comparative stability of perpendicular versus parallel double-locking plating systems in osteoporotic comminuted distal humerus fractures.
7. Stoffel K, Cunneen S, Morgan R, Nicholls R, Stachowiak GJ Orthop Res. 2008 Jun; 26(6):778-84.
8. Biomechanical comparison of two different periarticular plating systems for stabilization of complex distal humerus fractures. Schwartz A, Oka R, Odell T, Mahar

9. Atalar, A. C., Demirhan, M., Salduz, A., Kilicoglu, O., & Seyahi, A. (2009). Functional results of the parallel-plate technique for complex distal humerus fractures. Acta Orthop Traumatol Turc, 43(1), 21-7.
10. Athwal, G. S., Hoxie, S. C., Rispoli, D. M., & Steinmann, S. P. (2009). Precontoured parallel plate fixation of AO/OTA type C distal humerus fractures. Journal of orthopaedic trauma, 23(8), 575-580.
11. Dinesh, L. (2013). Functional Outcome Analysis of Parallel-Plate technique for distal humerus fractures (Doctoral dissertation, Madras Medical College, Chennai).
12. Sanders, R. A., Raney, E. M., & Pipkin, S. P. (1992). Operative treatment of bicondylar intraarticular fractures of the distal humerus.
13. Gofton, W. T., MacDermid, J. C., Patterson, S. D., Faber, K. J., & King, G. J. (2003). Functional outcome of AO type C distal humeral fractures. The Journal of hand surgery, 28(2), 294-308.
14. Robinson, C. M., Hill, R. M., Jacobs, N., & Dall, G. (2003). Adult distal humeral metaphyseal fractures: epidemiology and results of treatment. Journal of orthopaedic trauma, 17(1), 38-47.

Graft Options for Anterior Cruciate Ligament Reconstruction-choose wisely

Vijayan S, Hegde N, Kulkarni M S, Aroor M N, Bhat V, Rao S K

Study performed at Department of Orthopaedics, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, Udupi, Karnataka

Abstract

Background: Anterior cruciate ligament (ACL) tear constitutes a major chunk of post-traumatic knee injury leading to long term functional knee impairment and reduced quality of life. Globally, an increase in the incidence of reconstructive procedures for the torn ACL have been reported with varying outcome. This has revolutionized the techniques primarily aimed at achieving a functionally stable knee joint and early return to their pre-injury level of activities.

Discussion: Among the various factors which have influenced the outcome of the ACL reconstruction (ACLR), the choice of graft is a highly studied and yet still exceedingly debated topic. A large number of studies comparing the various graft options in ACLR has been published throughout the years. The purpose of this comprehensive review is to summarize the most recent relevant literatures on ACL graft options, on-going research and to discuss whether one graft type demonstrates clinical superiority over the other.

Conclusion: Understanding the biomechanical characteristics of various grafts available for anterior cruciate ligament reconstruction would help the surgeons in thoughtful selection of the graft for each patient on an individual basis and facilitate a thorough discussion between the surgeon and the patient which is vital in decision making.

Keywords: Anterior cruciate ligament; Graft; Reconstruction; Bone-patella; Hamstring; Peroneus; Quadriceps.

Address of correspondence:
Dr. Mahesh Suresh Kulkarni, MS Ortho, Assistant Professor, Department of Orthopaedics, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, Karnataka 576104
Email: aheshskulkarnibmc@gmail.com

How to site this article:
Sandeep Vijayan, Nikhil Hegde, Mahesh Suresh Kulkarni, Monappa Naik Aroor, Vishweshwar Bhat, Sharath K Rao, Graft Options for Anterior Cruciate Ligament Reconstruction- choose wisely. Orthop J MPC. 2022;28(1):18-26
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/149

Introduction: The incidence of injury to the anterior cruciate ligament (ACL) is increasing worldwide and reconstruction (ACLR) of the torn ligament is becoming a common surgery. The more common non-contact ACL injuries occur when landing on a slightly flexed knee that is loaded by moments in 3 orthogonal planes - an internally directed tibial torque and knee valgus moment, combined with a quadriceps muscle contraction to resist the flexion moment 1,2**.** The reconstruction surgeries which aim at restoring the stability and function of the knee and the techniques to achieve them are evolving day by day 3. Among the various variables which determine the success of the surgery, selection and use of the appropriate graft play a significant role.

ACL is mostly composed of type I collagen and has anteromedial and posterolateral bundles. The main functional role of the ACL is to provide stability against anterior tibial translation and internal rotation. It has an average ultimate failure load of 2160 N (± 157) N with a linear stiffness of 242 (± 28) N/mm. An ideal graft used for reconstruction should be easily available, cost-effective, easily harvested, have sufficient length and diameter, have the least donor site morbidity, should be biomechanically similar to the native ACL, allow secure fixation, permit good osteointegration in the bone tunnels, and have low immunogenicity and disease transmission rate 4–8**.**

There is no ideal graft still available for ACLR and the surgeons are often faced with the dilemma of selecting the most optimal graft. Choosing the graft depends on the skeletal age, degree of generalized ligamentous laxity, occupation of the patient, type of sporting activity involved in, chronicity of the injury, presence of associated ligamentous/meniscal injuries in the same knee and surgical familiarity of the surgeon 7,9.

The graft options currently available include autografts, allografts and synthetic grafts. The common autografts used in ACLR are Bone Patellar Bone Tendon (BPTB), Hamstring tendon (HT), Quadriceps tendon (QT) (with or without a bone plug on one end) and Peroneus longus tendon. Tendons and ligaments vary in the proportion of collagen in them. The ratio between type 1 and type 3 collagen in a tendon is 99:1, while it is 90:10 in ligaments 6,10**.**

The various allografts available are BPTB, HT, Tibialis posterior, Tibialis anterior and Tendoachilles. Allografts are available in irradiated and sterilized forms and also as fresh frozen-low irradiated grafts.

Synthetic grafts currently being used in practice are the Ligament augmentation and reconstruction system (LARS), Polyglycolic acid Dacron (PGA-Dacron) and Leeds Kio ligament.

Autografts

Bone patellar tendon bone graft:

Ever since Kenneth Jones (1963) and Franke K (1969) used BPTB for ACLR, it has been considered as the gold standard graft for ACLR (also known as Jones procedure) 2–4,8,9,11. The main reason for this is the excellent early bony integration in the bony tunnels due to the presence of bone on either end of the graft. This permits faster recovery, provide excellent tensile strength and a more stable knee with a lower incidence of graft failure 11–16. However, harvesting of BPTB graft is associated with several complications like patellar tendonitis, patellar or tibial fractures, loss of full extension with concentric and eccentric reduction of quadriceps power, anterior knee pain, difficulty in kneeling, numbness due to injury to the infrapatellar branch of the saphenous nerve, reduced range of motion due to rigid construct and graft-tunnel mismatch4–6,9,11,16. Using a transverse incision to harvest the graft is reported to reduce the incidence of kneeling pain 7,8. Few systematic reviews have shown a higher incidence of a contralateral ACL tear and osteoarthritis with BPTB grafts. The risk of patella fracture can be reduced by restricting the bone plug to less than half the length of the patella, making cuts angled and no more than 10 mm deep, avoiding cross-hatching at the corners and creating a trapezoidal cut rather than triangular or square 6. Previous patellar tendinopathy and Osgood Schlatter's disease are relative contraindications to the harvest of BPTB graft 7,8.

Hamstring graft:

Riccardo Galeazzi (1934) pioneered ACL reconstruction with a semitendinosus autograft. ACLR using four- strand hamstring grafts was first performed by Lipscombe in 1982 by open technique and arthroscopically by Friedman in 1988 9,10. Compared to BPTB graft, hamstring tendons are easier to harvest and have lower donor site morbidity 4,5,11,12,14. They have good tensile strength and does not affect knee extensor function. The hamstring tendon is also favoured for a transphyseal approach in skeletally immature patients to minimize the risk of bar formation and a secondary growth deformity 6,17**.** However, removal of the hamstring tendon leads to a reduction in knee flexion strength, can have saphenous nerve injury, have unpredictable graft length and diameter and takes longer time for bone-graft integration and recovery 5,11,18. The literature review has demonstrated bony tunnel widening especially when the graft has been anchored using cortical buttons with fixed or variable loop (Webster Kate, Ahmed). In general, the incidence of graft rupture is higher in the hamstring group and graft diameter is identified as a significant factor leading to early graft failure. Soft tissue grafts less than 8 mm in diameter in patients younger than 20 years of age has been found to be an independent predictor of the need for revision surgery for graft rupture 13,17,19. The height of the patient was found to be a strong

predictor of quadrupled hamstring graft diameter 20. Assessing the cross-sectional area of the semitendinosus tendon (ST) at the level of the knee joint line is used to predict the graft size. A different graft should be selected if the cross-section of the ST graft is < 5.9(mm2)17.

Quadriceps graft:

The use of quadriceps graft for ACLR was described by Marshall et al in 1979 21. It can be either a total soft tissue graft or can be harvested along with a piece of bone from the patella 17. Compared to BPTB there is no damage to the infrapatellar branch of the saphenous nerve and therefore lower rate of numbness, low patellar tendon morbidity and lower incidence of anterior knee pain 2,3,11,21. A graft of consistent length, thickness and width can be harvested by careful dissection without violating the supra-patellar pouch and reduces tibial tunnel widening 14,17,21. Midterm results of quadriceps tendon show a lesser rate of graft rupture, lower pain levels and analgesic consumption. Disadvantages of harvesting quadriceps graft include technical difficulties, anterior knee pain, quadriceps weakness, patellar fracture, decreased range of movement, extensive bleeding and retraction of rectus femoris tendon2,17.

Peroneus longus graft:

A relatively new entrant, but is as strong as native ACL. It is of adequate thickness and length. The distal portion of the peroneus longus is tenodesised to the peroneus brevis tendon. Though there were concerns about loss of plantarflexion of first the metatarsal, weakness of eversion and ankle instability, many reports are now available that there are no effects on gait parameters 22**.**

Allografts

Eugene Bircher (1929) was the first to use a xenograft (from Kangaroo) for ACLR. Allografts that are commercially available and commonly used include BPTB, Hamstring tendons, Tibialis posterior, Tibialis anterior and Tendo Achilles 4,11,14,18,23,24. There is no risk of donor site morbidity. Allografts permit shorter operating time through smaller cosmetic incisions and are associated with less pain. Since graft sizes are predictable and can fill large tunnels, allografts are generally preferred in multi-ligament and revision situations. It was reported that a high graft failure rate (up to 45%) happens with allograft 23**.** This was mainly attributed to the sterilization of the graft with ethylene glycol and high dose gamma irradiation as they alter the biomechanical properties of the graft 4,9,18,23. Newer studies have recommended using fresh frozen non-irradiated allografts or low dose irradiation (< 21kGy) that lead to a negligible change in biomechanical properties and better graft strength 3,14. Few other concerns linked to allografts include risk of disease transmission, possible immunogenicity, slower incorporation, increased cost and greater risk of graft failure in the younger age group 2,4,11,12,24. Young athletic patients who have primary ACL reconstruction with an allograft are 3 times more likely to have a graft failure than those with an autograft2,13. Allografts that have undergone a slower rehabilitation protocol is reported to have more favorable result2.

Synthetic grafts:

Issues like donor site morbidity with autografts and risk of immunogenicity and disease transmission with allografts prompted bioengineers to search for alternate graft materials. Synthetic graft materials became popular in the 1980s and early 1990s with the introduction of carbon fibre reinforced artificial graft. An ideal synthetic graft should be biocompatible and have mechanical characteristics similar to the native ligament. It should be chemically stable, absorb minimal water and have the presence of pores for fibroblast ingrowth4,9. Jenkins (1977) and Dandy (1981) were the first to use synthetic grafts2. The first generation made from carbon fibers were knitted, woven or braided. But it elongated and broke down and led to carbon induced synovitis. The second-generation grafts had additional braided woven longitudinal and transverse fibres4. They permitted fibroblast in-growth, but suffered from wear, fraying and low abrasion resistance. Currently, the third generation of synthetic graft is being used. The two commonly used third generation synthetic

ligaments are Ligament augmentation and reconstruction system (LARS) and PGA-Dacron 4,14. LARS is composed of longitudinal fibres of Polyethylene Terephthalate (PET) held together with a transverse knitted structure 2,25. While the intraarticular part has parallel longitudinal fibers of PET twisted perpendicular to each other, the intra-osseous (intra-tunnel) portion is composed of longitudinal fibers of PET with the transverse knitted structure which resists elongation. The intraarticular orientation of the fibers is modified to be side specific i.e. different for left and right knees and is supposed to help overcome rotational fatigue of the synthetic ligament. Hydroxypropylcellulose (HPC) coating is applied on the surface of the LARS ligament and found to improve its biocompatibility and enhance ligament tissue regeneration 6,25,26. PGA Dacron has 75% degradable polyglycolic acid filaments and 25% non-degradable Dacron thread wrapped in a free synovial graft. The synovial wrap around the graft which is usually harvested from the suprapatellar fossa serves as a source of healing fibroblasts 14.

As compared to the previous two generations where the synthetic graft was used to entirely substitute the torn ACL ligament, the current concept is to use it as an augmentation device during the healing process of a freshly injured ACL 9. Therefore, surgery must be planned soon after the injury and every effort should be made to preserve the native ACL stump. All stable ACL remnants, the notch synovium, fat pad and ligamentum mucosum must be preserved 9,14,27. PGA-Dacron graft can only be placed with a preserved ACL remnant. Sun et al reported superior vascular density, intra-tunnel and intra-articular graft integration and biomechanical properties, when the remnant was preserved 23,24. Benefits of remnant preservation include accelerated graft revascularization and remodeling, improved proprioception, decreased bone tunnel enlargement, individualized anatomic bone tunnel placement, improved objective knee stability and early mechanical support 9,14,24,28,29.

Synthetic grafts do not have donor site morbidity, have a longer shelf life and permit accelerated rehabilitation and early return to sports 24. It reduces surgical time and has no risk of disease transmission. They are generally considered in multi-ligament and revision surgeries 12,24.

The disadvantages of synthetic graft include its high cost, higher rate of graft rupture, late inflammation, delay in bone integration and can be considered only for a specific subset of patients who are > 40years, motivated, symptomatic and needing quick recovery 11,12,30. Rupture of the graft occurs due to abrasion of the graft at the tibial tunnel exit and is more vulnerable if impingement occurs 14,30.

Biological augments:

ACL graft-bone healing occurs with a layer of fibrovascular scar between tendon and bone at the graft-tunnel interface. This eventually organizes into perpendicular fibers that resemble Sharpey's fibers 1,6,28,31. The presence and number of these fibers are directly correlated with the pull-out strength. Biologic augmentation is used to either accelerate scar tissue formation or alter the integration to one that more closely resembles the native ACL enthesis28,29,32**.**

Biological materials in the form of Chitin, bioglass, gelatin, hyaluronic acid, polystyrene sodium sulfonate and collagen matrix enhance graft-tunnel interface healing 26,31. Biological coating with platelet-rich plasma, mesenchymal stem cells, fibrin matrix, platelet-leukocyte gel, and autologous platelet concentration and biosynthetic bone substitutes, such as demineralized bone matrix and recombinant bone xenograft enhance graft tunnel interface healing as they are osteoinductive and conductive 26,28,33. The excessive demineralized bone matrix may be used to fill the defect in the patella and tibia if a BPTB graft is harvested. This has shown to reduce the incidence of anterior knee pain and fractures 34.

Internal Brace Ligament Augmentation and Dynamic Intra-ligamentary Stabilization techniques are novel techniques that aim to protect the primary repair by providing a stabilizing construct that connects the femur and the tibia, thus bridging the repair

33,35,36. High strength suture tape acts as a stabilizer, enhancing the strength of the construct and allowing for graft preservation. It acts to protect the graft during the initial incorporation phase, while the patient can begin accelerated rehabilitation. Suture augmentation of ACL reconstruction may confer improved integrity of the graft and is worth consideration for future clinical study 11,26,33,37.

Augmentation of reconstruction with extra procedures:

Combined ACLR with augmentation of soft tissue structures (such as a lateral extra-articular tenodesis (LET) or reconstruction of the anterolateral ligament) can increase knee stability 15,28,38. Cerciello et al. recommended ACL + LET procedures to be considered in patients with grade 3+ pivot shift, patients less than 25 years, young patients undergoing ACLR with medial meniscus repair, those with Beighton score of > 6 or genu recurvatum > 100, patients taking part in pivoting sports like soccer, and patients undergoing revision ACLR39**.**

Comparative studies of various grafts

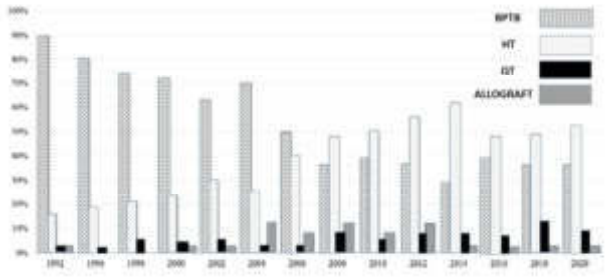
Many studies have compared the different autografts, allografts and synthetic grafts (**Table 1**). 2–5,12,14,16,17,21,23,24**.**

Table 1: Comparison of the biomechanical characteristics and functional outcome of various grafts available for anterior cruciate ligament reconstruction

	BPTB	Hamstring	Quadriceps	Allograft	Synthetic graft
Integration	Fast (6-8 wk)	Slow (10-12 wk)	Faster with bone plug	Slow	Used to augment torn ligament
Stability (mid-term)	Better stability	More anterior laxity	Laxity between BPTB and HT	Similar to BPTB	Provide immediate stability, Better stability than HT, Similar to BPTB
Return to sports	Early	Late	Late	Late return is better	Preferred for early return
Donor site morbidity	More	Less	Less than BPTB	Nil	Nil
Muscle strength	Extensor weakness	Weak flexion	Extensor weakness	No weakness	No weakness
Revision rate	Low (2.1%)	High (5.1%)	Low (0 - 2.2%)	More failure in < 25 yrs, More with irradiated graft, Fresh frozen, irradiated graft have low incidence	No difference compared to BPTB
Functional scores	Similar in all 4				No difference
Patient reported outcome scores	Similar in all 4				Better than autografts
Contralateral ACL tear and OA knee	More	Less	Less	Early OA can occur	No
Immunogenicity	No	No	No	Yes	Yes
Synovitis	No	No	No	Yes	Yes
Ultimate load to failure	2977 N	4090 N	2352 N	Variable	Variable
Cross sectional area (Normal 44mm2)	35 mm2	53 mm2	62 mm2	Variable	90 mm2

Over the years the choice of graft had changed across the world. The ACL study group ahead of their annual meeting in 2020 at Kitzbühel, Austria published the trend of graft usage over the last 3 decades. **(Figure 1**). From the early 1990s till 2006 the BPTB graft showed a downward trend and after 2006 the number of ACLRs using hamstring autograft began to rise. Though during 2008-2010 there was interest in shifting to allografts, currently, its usage as a primary graft has come down except in the setting of multi-ligament or revision settings 4,14,18. Quadriceps tendon (QT) autograft has increased in frequency since 2014 and peaked at over 10% in 2018 3. However, the majority (60%) still prefer hamstring autograft as their first choice.

Figure 1: Showing trend of ACL graft choice over the past 3 decades (Courtesy: Redrawn from Arnold MP et al. KSSTA Jan 2021. DOI: 10.1007/s00167-021-06443-9 PMID: 33486558)



On-going research

Pharmaceuticals – Alendronate, given locally or systemically was noted to improve bone tunnel mineralization, reduce peri tunnel bone loss and enhance graft-tunnel integration after six weeks. Subcutaneous parathyroid hormone showed enhanced thickness and microarchitecture of trabecular bone on CT scans. Oral Simvastatin was shown to promote bone formation 31**.**

Growth factors:

Growth factors can stimulate proliferation, migration and differentiation of cells. Platelet-derived growth factor, insulin-like growth factors and basic fibroblast growth factor can stimulate proliferation of fibroblasts while transforming growth factor-beta can increase matrix synthesis of tendon cells. They can increase the strength and stiffness of the healed ligaments. However, as their biological half-life is short, very high doses and repeated injections are often required 33,40.

Gene therapy:

Gene therapy is considered as the best method for local administration of growth factors. It can play a significant role in tissue-engineered ACL grafts. There are two ways in which the genetic material may be transferred to the tissue. First is via in-vivo transfer of the gene within a vector which is then directly applied to the target tissues. The second method involves harvesting the target tissues from the body, transfecting the vector into it and allowing them to grow in an in-vitro culture media. They are transferred back to the target area once tissues mature. The cells transduced by these vectors can act as a source of molecules capable of healing tissues. Viral and non-viral vectors can be used to deliver the genetic materials into the cells. Non-viral transfers are easier and have lower toxicity and low immunogenicity. However, viral gene vectors are more efficient. It is important to remove pathogenic genes before transfer. Insertional mutagenesis, abnormal regulation of cell growth, development of malignancy and chronic overexpression of growth factor proteins are potential complications of these transfers 10,40,41.

Stem cell therapy:

Most of the reported results of mesenchymal stem cells (MSC) are based on animal studies. MSCs can secrete soluble factors which alter the tissue microenvironment and help to repair tissue. Bone marrow is a rich source to acquire mesenchymal stem cells. These stem cells have greater transdifferentiation capability compared to stem cells from other sources. Micro-computed tomography and biomechanical analysis showed that BMP gene delivery led to enhanced bone formation at the graft-bone interface, osteointegration and superior biomechanical properties of the graft 32,35,41.

Platelet-rich plasma (PRP) may promote ligamentization, but there is less evidence to suggest that it enhances osseointegration 31. PRP increases the expression of collagen proteins, reduce apoptosis and stimulate fibroblast metabolic activity. However, most published studies on PRP combined with a collagen scaffold and mesenchymal stems cells have not been able to show any significant role of PRP in the acceleration of healing of soft tissue graft in a bone tunnel in ACLR 12,28,31,42.

Conclusion

We need to understand that there is **"No one-size-fits-all"** graft. It is very important to have an appropriate discussion with the patients as each patient has individualized goals and desires to do after reconstruction and this needs to be discussed in detail before selecting the best graft option for the patient.

Hamstring grafts appear to be a good all-around graft choice with fewer donor site complications and good results. BPTB is the best graft choice for professional sportspersons who are participating in sports at a very competitive level and wishing to have an early return to sports. Outcomes with quadriceps seem to lie between BPTB and Hamstrings and may be considered as an alternative graft option in indicated cases. Fresh frozen, non-irradiated allografts and augmentation with synthetic grafts may be considered in multiligament / revision setting in less active patients after explaining the pros and cons with the patient. Biological augmentation of graft is still in the experimental phase and we need to wait for long term results.

Reference

1. Dallo I, Chahla J, Mitchell JJ, Pascual-Garrido C, Feagin JA, LaPrade RF. Biologic Approaches for the Treatment of Partial Tears of the Anterior Cruciate Ligament: A Current Concepts Review. Orthopaedic Journal of Sports Medicine. 2017 Jan 1;5(1):1–26.
2. Ahmed MA, Xie ZG, Ahsan SM. Review of Graft Choices for Anterior Cruciate Ligament. jmscr. 2016 Dec 6;04(12):14402–14114.
3. Arnold MP, Calcei JG, Vogel N, Magnussen RA, Clatworthy M, Spalding T, et al. ACL Study Group survey reveals the evolution of anterior cruciate ligament reconstruction graft choice over the past three decades. Knee Surg Sports Traumatol Arthrosc [Internet]. 2021 Jan 24 [cited 2021 May 6]; Available from: http://link.springer.com/10.1007/s00167-021-06443-9
4. Dhammi I, Kumar S, Rehan-Ul-Haq. Graft choices for anterior cruciate ligament reconstruction. Indian J Orthop. 2015;49(2):127–8.
5. Tapasvi S, Jain S, Shyam A. BTB Vs Hamsrtings – Is There a Winner Yet? Asian Journal of Arthroscopy. 2016 Jun;1(1):11–5.
6. Ranjan R, Asif N. Choices of graft for anterior cruciate ligament reconstruction. Saudi J Sports Med. 2016;16(1):7–14.
7. Feller JA, Webster KE. A Randomized Comparison of Patellar Tendon and Hamstring Tendon Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2003 Jul 1;31(4):564–73.
8. Webster KE, Feller JA, Hartnett N, Leigh WB, Richmond AK. Comparison of Patellar Tendon and Hamstring Tendon Anterior Cruciate Ligament Reconstruction: A 15-Year Follow-up of a Randomized Controlled Trial. Am J Sports Med. 2016 Jan 1;44(1):83–90.
9. Shaerf DA. Anterior cruciate ligament reconstruction best practice: A review of graft choice. WJO. 2014;5(1):23–9.
10. Sundararajan SR, Sambandam B, Rajasekaran S. Future Trends In Grafts Used In ACL Reconstruction. Asian Journal of Arthroscopy. 2016 Jun;1(1):29–34.
11. Cerulli G, Placella G, Sebastiani E, Tei MM, Speziali A, Manfreda F. ACL Reconstruction: Choosing the Graft. joints. 2013;1(1):18–24.
12. Vaishya R, Agarwal AK, Ingole S, Vijay V. Current Trends in Anterior Cruciate Ligament Reconstruction: A Review. Cureus [Internet]. 2015 Nov 13 [cited 2021 May 6]; Available from: http://www.cureus.com/articles/3376-current-trends-in-anterior-cruciate-ligament-reconstruction-a-review
13. Kyung H-S. Graft considerations for successful anterior cruciate ligament reconstruction. Knee Surg & Relat Res. 2019 Dec;31(1):1–2.
14. Lanoue P. Does an ACL autograft, allograft or synthetic graft lead to improved long term knee stability? [Internet] [Physician Assistant Studies]. [Minneapolis]: Augsburg University; 2020. Available from: https://idun.augsburg.edu/etd/1060
15. Campos GC de, Nunes LFB, Arruda LRP, Teixeira PEP, Amaral GHA, Alves Junior W de M. Current panorama of anterior cruciate ligament reconstruction surgery in Brazil. Acta ortop bras. 2019 Jun;27(3):146–51.

16. Rahardja R, Zhu M, Love H, Clatworthy MG, Monk AP, Young SW. Effect of Graft Choice on Revision and Contralateral Anterior Cruciate Ligament Reconstruction: Results From the New Zealand ACL Registry. Am J Sports Med. 2020 Jan 1;48(1):63–9.
17. Grassi A, Carulli C, Innocenti M, Mosca M, Zaffagnini S, Bait C, et al. New Trends in Anterior Cruciate Ligament Reconstruction: A Systematic Review of National Surveys of the Last 5 Years. Joints. 2018 Sep;06(03):177–87.
18. Mistry H, Metcalfe A, Colquitt J, Loveman E, Smith NA, Royle P, et al. Autograft or allograft for reconstruction of anterior cruciate ligament: a health economics perspective. Knee Surg Sports Traumatol Arthrosc. 2019 Jun;27(6):1782–90.
19. Perkins CA, Busch MT, Christino M, Herzog MM, Willimon SC. Allograft Augmentation of Hamstring Anterior Cruciate Ligament Autografts Is Associated With Increased Graft Failure in Children and Adolescents. Am J Sports Med. 2019 Jun;47(7):1576–82.
20. Stergios PG, Georgios KA, Konstantinos N, Efthymia P, Nikolaos K, Alexandros PG. Adequacy of Semitendinosus Tendon Alone for Anterior Cruciate Ligament Reconstruction Graft and Prediction of Hamstring Graft Size by Evaluating Simple Anthropometric Parameters. Anatomy Research International. 2012 Jul 29;2012:1–8.
21. Hurley ET, Calvo-Gurry M, Withers D, Farrington SK, Moran R, Moran CJ. Quadriceps Tendon Autograft in Anterior Cruciate Ligament Reconstruction: A Systematic Review. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2018 May;34(5):1690–8.
22. Kumar V K, Narayan S K, Vishal R B. A study on peroneus longus autograft for anterior cruciate ligament reconstruction. Int J Res Med Sci. 2019 Dec 25;8(1):183–8.
23. Macaulay AA, Perfetti DC, Levine WN. Anterior Cruciate Ligament Graft Choices. Sports Health. 2012 Jan;4(1):63–8.
24. Sun J, Wei X, Li L, Cao X, Li K, Guo L, et al. Autografts vs Synthetics for Cruciate Ligament Reconstruction: A Systematic Review and Meta-Analysis. Orthop Surg. 2020 Apr;12(2):378–87.
25. Yang J, Dong Y, Wang J, Chen C, Zhu Y, Wu Y, et al. Hydroxypropylcellulose Coating to Improve Graft-to-Bone Healing for Anterior Cruciate Ligament Reconstruction. ACS Biomater Sci Eng. 2019 Apr 8;5(4):1793–803.
26. Herald J, Kakatkar S. Synthetic Grafts in Anterior Cruciate Ligament Reconstruction. Asian Journal of Arthroscopy. 2016 Jun;1(1):16–9.
27. Ebert JR, Annear PT. ACL Reconstruction Using Autologous Hamstrings Augmented With the Ligament Augmentation and Reconstruction System Provides Good Clinical Scores, High Levels of Satisfaction and Return to Sport, and a Low Retear Rate at 2 Years. Orthopaedic Journal of Sports Medicine. 2019 Oct 1;7(10):1–10.
28. Riediger MD, Stride D, Coke SE, Kurz AZ, Duong A, Ayeni OR. ACL Reconstruction with Augmentation: a Scoping Review. Curr Rev Musculoskelet Med. 2019 Jun;12(2):166–72.
29. Rothrauff BB, Kondo E, Siebold R, Wang JH, Yoon KH, Fu FH. Anterior cruciate ligament reconstruction with remnant preservation: current concepts. J ISAKOS. 2020 May;5(3):128–33.
30. Bashaireh K, Audat Z, Radaideh AM, Aleshawi AJ. The Effectiveness of Autograft Used in Anterior Cruciate Ligament Reconstruction of the Knee: Surgical Records for the New Generations of Orthopedic Surgeons and Synthetic Graft Revisit. ORR. 2020 Jun;Volume 12:61–7.
31. Hexter AT, Thangarajah T, Blunn G, Haddad FS. Biological augmentation of graft healing in anterior cruciate ligament reconstruction: a systematic review. The Bone & Joint Journal. 2018 Mar;100-B(3):271–84.
32. Yates EW, Rupani A, Foley GT, Khan WS, Cartmell S, Anand SJ. Ligament Tissue Engineering and Its Potential Role in Anterior Cruciate Ligament Reconstruction. Stem Cells International. 2012;2012:1–6.
33. Mahapatra P, Horriat S, Anand BS. Anterior cruciate ligament repair – past, present and future. J EXP ORTOP. 2018 Dec;5(1):1–10.
34. Lavender C, Johnson B, Kopiec A. Augmentation of Anterior Cruciate Ligament Reconstruction With Bone Marrow Concentrate and a Suture Tape. Arthroscopy Techniques. 2018 Dec;7(12):e1289–93.

35. Sciarretta FV. History of anterior cruciate ligament surgery. JASSM. 2020 Jul 15;1:90–7.
36. Benson DM, Hopper GP, Wilson WT, Mackay GM. Anterior Cruciate Ligament Reconstruction Using Bone–Patellar Tendon–Bone Autograft With Suture Tape Augmentation. Arthroscopy Techniques. 2021 Feb;10(2):e249–55.
37. Lai VJ, Reynolds AW, Kindya M, Konicek J, Akhavan S. The Use of Suture Augmentation for Graft Protection in ACL Reconstruction: A Biomechanical Study in Porcine Knees. Arthroscopy, Sports Medicine, and Rehabilitation. 2021 Feb;3(1):e57–63.
38. Lau BC, Rames J, Belay E, Riboh JC, Amendola A, Lassiter T. Anterolateral Complex Reconstruction Augmentation of Anterior Cruciate Ligament Reconstruction: Biomechanics, Indications, Techniques, and Clinical Outcomes. JBJS Rev. 2019 Nov;7(11):e5–e5.
39. Cerciello S, Batailler C, Darwich N, Neyret P. Extra-Articular Tenodesis in Combination with Anterior Cruciate Ligament Reconstruction. Clinics in Sports Medicine. 2018 Jan;37(1):87–100.
40. Martinek V, Huard J, Fu FH. Gene Therapy in Tendon Ailments. In: Maffulli N, Renström P, Leadbetter WB, editors. Tendon Injuries [Internet]. London: Springer-Verlag; 2005 [cited 2021 May 6]. p. 307–12. Available from: http://link.springer.com/10.1007/1-84628-050-8_30
41. Bez M, Kremen TJ, Tawackoli W, Avalos P, Sheyn D, Shapiro G, et al. Ultrasound-Mediated Gene Delivery Enhances Tendon Allograft Integration in Mini-Pig Ligament Reconstruction. Molecular Therapy. 2018 Jul;26(7):1746–55.
42. Andriolo L, Di Matteo B, Kon E, Filardo G, Venieri G, Marcacci M. PRP Augmentation for ACL Reconstruction. BioMed Research International. 2015;2015:1–15.

A retrospective analysis of return to sports after 9 months in athletes in cases of anterior cruciate ligament reconstruction.

Butala R P, Parelkar K, Syal A D, Chandiramani V.

This study is performed at Department of Orthopaedics, D. Y. Patil Hospital and research centre, Nerul, Navi Mumbai, Maharashtra

Abstract

Background: The anterior cruciate ligament (ACL) is responsible for maintaining stability of the knee joint, particularly in activities involving pivoting or kicking. The knee loses its stability if the ACL is ruptured and the joint may become more damaged over time. ACL reconstruction is the surgical treatment of choice. Aim of this study is to analyze the rate of return to sports after 9 months in cases of anterior cruciate ligament reconstruction.

Material & Methods: All cases operated for ACL reconstruction between the year 2017- 2020 were studied .This group included 80 patients with traumatic twisting, pivoting injury while playing sports, diagnosed with ACl tear, with instability at the knee joint .Exclusion criteria included avulsion injuries, meniscus involvement, posterior collateral ligament involvement, collateral involvement and any fracture of either femur or tibia involvement. The Scoring system used is ACL RSI (anterior cruciate ligament return to sport and injury scale).

Results: Total eighty athletes were included in this study. There was no association of symmetrical muscle function or quadriceps strength .The patients with a lower ACL RSI (anterior cruciate ligament –return to sport and injury scale) score had a lower rate of return to sports after 9 months post ACL reconstruction as well as a higher rate of secondary ACL injury.

Conclusion: Athletes operated for ACL reconstruction showed a low rate of return to their sports after 9 months. One of the potential concerns was with returning to sports the re-injury rate to the reconstructed ACL or to the other structures (cartilage, menisci or other ligaments) (1-3). Approximately 1 in 4 patients who are 25 years of age or younger and return to high-risk sport after primary anterior cruciate ligament (ACL) reconstruction sustain a second ACL injury (4).

Keywords: Anterior cruciate ligament reconstruction, return to sport activity.

Address of correspondence:
Dr Kedar Parelkar,
Department of Orthopaedics,
D. Y. Patil Hospital and research centre, Nerul, Navi Mumbai, Maharashtra.

How to cite this article:
Butala R P, Parelkar K, Syal A, Chandiramani V. A retrospective analysis of return to sports after 9 months in athletes in cases of anterior cruciate ligament reconstruction. Orthop J MPC. 2022;28(1):27-35
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/151

Introduction

The ACL is extra synovial collagenous structure which is intra-articular with limited healing capacity that originates at the posteromedial aspect of the lateral femoral condyle and crosses anteromedially to insert anterior to the intercondylar eminence of tibial articular surface. It is constituted by two functional bundles: the anteromedial (tight in flexion, 60-900) and the posterolateral (tight in full extension) (5, 6). It receives innervation from the posterior articular nerve, a branch of the tibial nerve, which supplies mechanoreceptors that play a vital role in proprioception. Hence, an ACL injury causes partial deafferentation and alters spinal and supraspinal motor control, thus affecting proprioception (7, 8).

The anterior cruciate ligament (ACL) injuries are amongst the most common and significant

knee ligament injuries occurring in athletes and evaluated by sports medicine practitioners. One of the most common mechanisms that affects females is called "position of no return," in which the athlete lands with an extended hip and knee, knee in valgus, internally rotated tibia, and a pronated foot (9, 10).

Women who participate in athletics are two to eight times more likely to sustain ACL injury than male counterparts in the same landing and pivoting sports (11, 12). Anterior cruciate ligament tear can occur due to both noncontact and contact mechanisms. Approximately 70% to 80% of the ACL tears occur due to noncontact mechanisms associated to landing from a jump, changing direction, or sudden deceleration.

Acute management after ACL tear consists of ligament reconstruction predominantly in young high-level athletes participating in high-demand sports and those with persistent functional knee instability(13,14). The primary function of the ACL is to prevent the excessive anterior tibial translation .This function is carried out mainly by the anteromedial fibers of the ACL .The other important function includes limiting the varus / valgus stress when the knee is in full extension and the rotatory movements which is the function of the posterolateral fibers (15). Significant stress upon the ACL is observed in the last 30 degrees of extension and hyperextension, along with valgus and internal rotation forces (16, 17).

Although not clearly established in many studies (18), several factors need to be evaluated when determining if the patient should return to play (return to sports) after injury or anterior cruciate ligament reconstruction (ACLR).

The first and most important question that the athlete will want answered is "When can I return to the sport?" after an ACL injury. Recently published literature has established that return to sports could be slower than was previously reported, and that better results are obtained after 9 months after reconstruction surgery (19,20).

The objective of this article is to analyze and evaluate the rate of return to sports by athletes after 9 months of ACL reconstruction surgery.

Materials and method

All cases admitted to tertiary care center with a diagnosis of post traumatic ACL tear and above were studied.

Exclusion criteria included ACL avulsion injuries, meniscus involvement, posterior collateral ligament involvement, collateral involvement and any fracture of either femur or tibia involvement.

Analysis of the number of athletes who returned to sports after their ACL reconstruction surgery was done. All procedures were performed by surgeons with a similar level of training.

The study done after following guidelines laid down by the department of orthopedics and all required consents were taken as per the criteria set forth by the declaration of good clinical practice by Helsinki.Pre-operative data such as age, sex, weight, pre-operative deformity, pre-operative knee function (pre injury level of activity/sport) and quadriceps strength and the absence of effusion was collected.

TABLE 1: Profile of patients included (n=50)

Age (yrs.)	Statistic	
Median	30	
Mean	28.56	
SD	7.38	
95% C.I. for mean	26.46 to 30.66	
Min.	18	
Max.	47	
	No.	%
Gender		
• Male	38	76.0%
• Female	12	24.0%
Side		
• Left	20	40.0%
• Right	30	60.0%

Pre-operative intervention:- Goals of pre-operative rehabilitation program included reducing the pain, inflammation, swelling, normal range of motion and gait. All patients in the study received prehabilitation with a good pre-operative protocol which included immobilization/stabilizing the knee joint post

knee injury with long knee brace, pain management with IV/oral analgesics and chymotrypsin/trypsin to reduce the swelling. After the pain and swelling subsided the focus of prehabilitation was shifted to regaining full range of movement at knee joint. Quadriceps strength was also given due importance pre-operatively. A 20% deficit in quadriceps strength before surgery, can predict a significant strength deficiency 2 years after surgery (21, 22).

	Median	*Mean*	*SD*	*95% CI*	*Min.*	*Max.*
Emotions						
1. Are you afraid of accidentally injuring your knee by playing your sport	50	49.80	17.90	44.71 to 54.89	10	90
2. Are you confident about your ability to perform well at your sport	50	49.40	19.21	43.94 to 54.86	10	100
3. Are you confident about your knee holding up under pressure	50	51.80	20.97	45.84 to 57.76	10	100
4. Are you confident that you can perform at your previous level of sport participation	50	48.80	17.80	43.74 to 53.86	10	100
5. Are you confident that you could play your sport without concern for your knee	40	47.80	17.65	42.79 to 52.82	20	90
Confidence in performance						
6. Are you confident that your knee will not give way by playing your sport	50	51.00	21.78	44.81 to 57.19	20	100
7. Are you fearful of reinjuring your knee by playing your sport	50	51.40	20.70	45.52 to 57.28	20	100
8. Are you nervous about playing your sport	50	50.60	21.80	44.41 to 56.80	10	100
9. Do thoughts of having to go through surgery and rehabilitation again prevent you from playing your sport	50	51.80	18.37	46.58 to 57.02	10	100
10. Do you feel relaxed about playing your sport	50	50.80	20.19	45.06 to 56.54	20	100
Risk appraisal						
11. Do you find it frustrating to have to consider your knee with respect to your sport	50	50.20	18.46	44.95 to 55.45	20	90
12. Do you think you are likely to re injure your knee by participating in your sport	50	46.00	22.32	39.66 to 52.34	10	90

TABLE 3:- **ACL-RSI sub-domain scores and total scores**

	Median	*Mean*	*SD*	*95% CI*	*Min.*	*Max.*
Emotions	45	48.84	17.77	43.79 to 53.89	20	88
Confidence in performance	46	51.00	16.65	46.27 to 55.73	22	80
Risk appraisal	45	50.10	18.36	44.88 to 55.32	15	100
ACL-RSI total score	46.67	49.95	16.75	45.19 to 54.71	25	85.83

Operative management:-The factors that influenced the outcome of ACL reconstruction surgery were anatomical position, tensioning, tunnel position and graft choice (23,24,25). Two grafts are commonly used for such a procedure either an auto-graft or an allograft .Less failure rates have been reported in auto-grafts as compared to all- grafts in young athletes. Among the most commonly used auto-grafts are the bone-patellar tendon-bone (BTB) and hamstring tendon (HT) (26). BTB auto-graft allows for bone-to-bone healing, while achieving better graft strength and stable positioning relative to screw fixation (27). Recent literature suggests that the tunnel placement preferred by surgeons is the 11 o'clock position on the frontal view of the knee. Biomechanical studies have suggested that this femoral tunnel placement could not satisfactorily achieve the needed rotatory knee stability, whereas a more lateral placement towards the footprint of the PL bundle, i.e., the 10 o'clock position yielded better results (28). All tunnel placement in the athletes operated were at the 10 o'clock position. Still, it has been shown that there is no single position that could produce the rotatory knee stability close to that of the intact knee (28).

Post-operative factors:-The factors that play an important role in successful rehabilitation after ACL reconstruction surgery are a participation in a good rehabilitation program, psychological readiness and time from surgery. Progressively, emphasis was given on strengthening programs including closed and open kinetic chain (OKC) exercises, neuromuscular control, balance/proprioceptive exercises, and subsequent sport-specific training (29, 30, 31, 32).

Physiotherapy:-

Goals post-operatively:-

1. Control pain and swellings
2. Care for the knee and dressing
3. Early range of motion exercises
4. Achieve and maintain full passive extension
5. Prevent shutdown of the quadriceps muscles
6. Gait training

Weight bearing status- This applies to all ACL reconstruction unless otherwise specified.

1. Day 1-7 = 50% body weight (2 crutches).

2. Day 8-14 = 50-75% body weight (1 crutch).
3. End of week 2 = full weight bearing.

After 2 weeks postoperatively after 2 weeks:-

Goals:-

1. Maintain full extension
2. Achieve 100 - 120 degrees of flexion
3. Develop enough muscular control to wean off knee immobilizer
4. Control swelling in the knee

After 4-6 weeks of surgery:-
Goals:

1. 125 degrees of flexion pushing toward full flexion
2. Continued strength building

Complication: Amongst our limited study group we found 2 cases of post-operative stiffness which presented as lack of full ROM in extension within 2 weeks, one of the reasons for such a complication may have been placement of femoral and tibial tunnel or tensioning of graft at near terminal extension. These patients were advised aggressive post-operative rehabilitation which showed good results and the athletes regained full extension. Such complications can also be managed by drop out casting or in severe cases arthroscopic adhesiolysis specifically in refractory cases. In cases where full flexion isn't achieved manipulation under anesthesia may help to regain lost flexion (33).

Statistical analysis-The return to sports was calculated based on a follow up kept over a time of 9 months to analyze the number of athletes who return to their sports after 9 months .A total of 80 athletes were considered for this study, out of which based on the exclusion criteria 25 patients were eliminated due other associated injuries along with ACL injury, from the 55 athletes included 5 where lost during follow up .The final analysis group included 50 patients. Scoring system used is ACL RSI (anterior cruciate ligament return to sport and injury scale).

The ACL-RSI comprises 12 questions where patients grade their answers on a Likert scale ranging from zero to 100 with ten-point increments (34). Higher scores indicate greater psychological readiness towards RTS (35).

Results

Eighty athletes were considered in this study, from which fifty athletes completed the study. The main reason for exclusion was other ligament and/or meniscus involvement. The athletes had an average age (mean age =28.56) . Only 55% athletes returned to strenuous sports between a time of 6 to 12 months. After returning to sports and answering the questionnaire, time ranged from 5 days to 2 months.

The study also suggested that athletes who returned to sports at 9 months showed a lower rate of re-injury as compared to those who returned earlier. Based on the results of the questionnaire, it can be suggested that athletes who scored low on the questionnaire were higher in number as compared to those who scored higher.

The study also showed a direct correlation between a low ACL-RSI score and a low rate of return to sports by athletes. These findings can be attributed to various reasons such as decreased level of confidence, fear of re-injury, increased level of frustration having to consider the knee while playing, fear of having to under-go rehabilitation again, increased level of nervousness while playing the sport, worry about the knee holding up under pressure while playing and lastly fear of suffering through similar pain which occurred after the first injury.

Discussion

The most important finding of the present study was Psychological and physical readiness to RTS does not necessarily coincide. Studies based on evaluating the physiological readiness are hence both warranted as well as necessary. This assessment with the ACL-RTI was performed approximately 9 months after surgery with help of a valid and easy to answer questionnaire.

Various studies demonstrate that patients who receive prehabilitation are able to recover full ROM, have lower risk of developing knee

stiffness and arthrofibrosis after surgery, improve quadriceps activation, and reduce muscle atrophy caused by loss of neuromuscular control (36, 37) . It was also noted that loss of ROM, particularly knee extension pre-operatively, leads to unfavorable results after ACLR (38).

Laboratory studies have found that an initial graft tension of 88 N resulted in an overly constrained knee, while a lower initial graft tension of 44 N would be more suitable (39). On the contrary, an in vivo study on goats found no significant differences in knee kinematics and in situ forces, between high (35 N) and low (5 N) initial tension groups at 6 weeks after surgery (40). Thus, the literature is confusing and definitive answers on initial graft tension remain unknown (41). There are advocates of early and aggressive postoperative rehabilitation as well as neuromuscular training to help athletes return to sports as early as possible (42).On the other hand some studies suggest that RTP is more dependent on the postoperative rehabilitation program than the graft selection and tensioning (43, 44).

As traditional single bundle ACL reconstruction could not fully restore rotatory knee stability, investigators have explored anatomic double bundle ACL reconstruction for ACL replacement (45, 46, 47, 48). Biomechanical studies have revealed that an anatomic double bundle ACL reconstruction has clear advantages in terms of achieving kinematics at the level of the intact knee with concomitant improvement of the in situ forces in the ACL graft closer to those of the intact ACL, even when the knee is subjected to rotatory loads (49).

Many rehabilitation protocols have been described such as the accelerated program that was initially described by shelbourne and nitz(50). A subsequent study demonstrated no difference in subjective or objective outcomes after ACLR between accelerated and traditional rehabilitation programs (19 vs 32 wk) in patients with BTB autografts (51).

In addition to physical readiness, fear of re-injury due to the physiological state of the patient also plays an important role in returning to sports participation. Although not routinely used, there are several scoring systems available to address the psychological state after ACLR (52). For example, the Tampa Scale for Kinesiophobia (53) and ACL Return to Sport after Injury Scale (54). There are multiple causative factors for symptom recurrence, including but not limited to repeat trauma, infections, technical errors, lack of biologic healing or fixation, or some combination of these causes (55, 56). The percentage of graft failures and contralateral tears has been reported to occur in between 4% and 27% of reconstructed patients, with a higher percentage occurring in the first year (57, 58). A young athlete returning to sport within 1 year of surgery is 15 times more likely to suffer a second ACL tear when compared with a healthy athlete (59). Among the technical factors that can influence and increase the amount of recurrent injuries, tunnel malposition should be highlighted, with the femoral insertion being the primary cause (60). Ideally, proper tension should avoid the laxity caused by the insufficient ligament; without causing overt constriction that may lead to increased joint contact pressures and resultant collagen myxoid degeneration and intra-substance graft necrosis (61). Various studies have shown that using allografts in patients under 25 years of age have a higher likelihood of failing, particularly those allografts that have been irradiated (62, 63). When comparing auto-grafts, multiple systematic reviews have been published with mixed results, leading some surgeons to select the harvest site depending on surgeon comfort or based on anatomy and sport-specific demand (64, 65). The MARS group reported that 7% of failures may be attributed to biologic causes (66).

Conclusion

The study results support the clinical observation that the patients who score poorly on the ACL-RSI score system performed poorly and also showed a lower rate of return to their sport. Hence for the current athletes as well as young and active population it is acceptable to infer that the ability of a post ACL reconstruction patient to active life style or their sport is closely related to the ACL-RSI score. In the above study out of a total of 38

male athletes and 12 female athletes (table-1) the ones who returned to pre-injury activity scored significantly higher on ACL-RSI score as compared to those who scored low on the ACL-RSI score. Based on the questionnaire (table-2) it was noted that (mean=48.80) athletes only had the confidence that they would be able perform at their pre-injury level in their sport. It was also taken into account that (mean= 51.50) athletes had a fear of re-injury. A mean of the total ACL-RSI score of this study was only 49.95 (table-3), which also indicates a low rate of return to sports after 9 month of ACL reconstruction amongst athletes. These findings are in coherence with growing evidence that suggests the validity of the ACL-RSI score and also implies that surgeons need to use both physiological and physical tests in their evaluation of the readiness to return to sports after ACL reconstruction surgery in athletes.

Abbreviations

- ACL- anterior cruciate ligament.
- ACL RSI - anterior cruciate ligament return to sport and injury scale.
- ACLR - anterior cruciate ligament reconstruction.
- BTB - bone-patellar tendon-bone.
- HT-hamstring tendon.
- OKC - open kinetic chain.

References

1. Sandberg R, Balkfors B. Reconstruction of the anterior cruciate ligament. A 5-year follow-up of 89 patients. Acta Orthop Scand 1988;59:288–93
2. Otto D, Pinczewski LA, Clingeleffer A, et al. Fiveyear results of single-incision arthroscopic anterior cruciate ligament reconstruction with patellar tendon autograft. Am J Sports Med 1998;26:181–8
3. Bak K, Scavenius M, Hansen S, et al. Isolated partial rupture of the anterior cruciate ligament. Long-term follow-up of 56 cases. Knee Surg Sports Traumatol Arthrosc 1997;5:66–71
4. Wiggins AJ, , Grandhi RK, , Schneider DK, , Stanfield D, , Webster KE, , Myer GD. and Risk of secondary injury in younger athletes after anterior cruciate ligament reconstruction: a systematic review and meta-analysis. Am J Sports Med. 2016; 44: 1861– 1876. https://doi.org/10.1177/0363546515621554Crossref Medline Google Scholar
5. Gabriel MT, Wong EK, Woo SL, et al. Distribution of in situ forces in the anterior cruciate ligament in response to rotatory loads. J. Orthop. Res. 2004; 22:85Y9.
6. Miller MD. The Knee and Lower Leg: Essential Orthopaedics. 1st ed. Philadelphia: Saunders, 2010.
7. van Melick N, van Cingel RE, Brooijmans F, et al. Evidence-based clinical practice update: practice guidelines for anterior cruciate ligament rehabilitation based on a systematic review and multidisciplinary consensus. Br. J. Sports Med. 2016; 50:1506Y15.
8. Zimny ML, Schutte M, Dabezies E. Mechanoreceptors in the human anterior cruciate ligament. Anat. Rec. 1986; 214:204Y9.
9. Boden BP, Dean GS, Feagin JA, Garrett WE. Mechanisms of anterior cruciate ligament injury. Orthopedics. 2000; 23:573Y8.
10. Hewett TE, Myer GD. The mechanistic connection between the trunk, hip, knee, and anterior cruciate ligament injury. Exerc. Sport Sci. Rev. 2011; 39:161Y6.
11. Arendt E, Dick R. Knee injury patterns among men and women in collegiate basketball and soccer. NCAA data and review of literature. Am. J. Sports Med. 1995; 23:694Y701.
12. Hewett TE, Ford KR, Myer GD. Anterior cruciate ligament injuries in female athletes: part 2, a meta-analysis of neuromuscular interventions aimed at injury prevention. Am. J. Sports Med. 2006; 34:490Y8.
13. Fithian DC, Paxton EW, Stone ML, et al. Prospective trial of a treatment algorithm for the management of the anterior cruciate ligament-injured knee. Am. J. Sports Med. 2005; 33:335Y46.
14. Fu FH, Schulte KR. Anterior cruciate ligament surgery 1996. State of the art? Clin. Orthop. Relat. Res. 1996:19Y24.

15. Chhabra A, Starman JS, Ferretti M, et al. Anatomic, radiographic, biomechanical, and kinematic evaluation of the anterior cruciate ligament and its two functional bundles. J. Bone Joint Surg. Am. 2006; 88(Suppl. 4):2Y10.
16. Li G, DeFrate LE, Sun H, Gill TJ. In vivo elongation of the anterior cruciate ligament and posterior cruciate ligament during knee flexion. Am. J. Sports Med. 2004; 32:1415Y20.
17. Quatman CE, Kiapour AM, Demetropoulos CK, et al. Preferential loading of the ACL compared with the MCL during landing: a novel in sim approach yields the multiplanar mechanism of dynamic valgus during ACL injuries. Am. J. Sports Med. 2014; 42:177Y86.Barber-Westin SD, Noyes FR. Factors used to determine return to unrestricted sports activities after anterior cruciate ligament reconstruction. Arthroscopy. 2011; 27:1697Y705.
18. Grindem H, Snyder-Mackler L, Moksnes H, et al. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. Br. J. Sports Med. 2016; 50:804Y8.
19. Nagelli CV, Hewett TE. Should return to sport be delayed until 2 years after anterior cruciate ligament reconstruction? Biological and functional considerations. Sports Med. 2017; 47:221Y32.
20. de Jong SN, van Caspel DR, van Haeff MJ, Saris DB. Functional assessment and muscle strength before and after reconstruction of chronic anterior cruciate ligament lesions. Arthroscopy. 2007; 23:21Y8, 28.e1-3.
21. Shaarani SR, O'Hare C, Quinn A, et al. Effect of prehabilitation on the outcome of anterior cruciate ligament reconstruction. Am. J. Sports Med. 2013; 41:2117Y27.
22. Amiel D, Kleiner JB, Roux RD, et al. The phenomenon of ''ligamentization'': anterior cruciate ligament reconstruction with autogenous patellar tendon. J. Orthop. Res. 1986; 4:162Y72.
23. Arnoczky SP, Tarvin GB, Marshall JL. Anterior cruciate ligament replacement using patellar tendon. An evaluation of graft revascularization in the dog. J. Bone Joint Surg. Am. 1982; 64:217Y24.
24. Fernandes TL, Fregni F, Weaver K, et al. The influence of femoral tunnel position in single-bundle ACL reconstruction on functional outcomes and return to sports. Knee Surg. Sports Traumatol. Arthrosc. 2014; 22:97Y103.
25. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 12 Ver. VI (Dec. 2015), PP 59-62 www.iosrjournals.org
26. Pauzenberger L, Syre´ S, Schurz M. ''Ligamentization'' in hamstring tendon grafts after anterior cruciate ligament reconstruction: a systematic review of the literature and a glimpse into the future. Arthroscopy. 2013; 29:1712Y21.
27. Mehta VM, Mandala C, Foster D, Petsche TS. Comparison of revision rates in bone-patella tendon-bone auto-graft and allograft anterior cruciate ligament reconstruction. Orthopedics. 2010; 33:12.
28. Myer GD, Ford KR, Barber Foss KD, et al. The relationship of hamstrings and quadriceps strength to anterior cruciate ligament injury in female athletes. Clin. J. Sport Med. 2009; 19:3Y8.
29. Nagelli CV, Hewett TE. Should return to sport be delayed until 2 years after anterior cruciate ligament reconstruction? Biological and functional considerations. Sports Med. 2017; 47:221Y32.
30. Sugimoto D, Myer GD, Foss KD, Hewett TE. Specific exercise effects of preventive neuromuscular training intervention on anterior cruciate ligament injury risk reduction in young females: meta-analysis and subgroup analysis. Br. J. Sports Med. 2015; 49:282Y9.
31. Wilk KE, Reinold MM, Hooks TR. Recent advances in the rehabilitation of isolated and combined anterior cruciate ligament injuries. Orthop. Clin. North Am. 2003; 34:107Y37.
32. Petsche TS, Hutchinson MR. Loss of extension after reconstruction of the anterior cruciate ligament. J Am Acad Orthop Surg. 1999;7:119–127. [PubMed] [Google Scholar]
33. Webster KE, Feller JA, Lambros C (2008) Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. Phys Ther Sport 9:9–15

34. Webster KE, Feller JA (2018) Development and Validation of a Short Version of the Anterior Cruciate Ligament Return to Sport After Injury (ACL-RSI) Scale. Orthop J Sports Med 6:1–7
35. Magit D, Wolff A, Sutton K, Medvecky MJ. Arthrofibrosis of the knee. J. Am. Acad. Orthop. Surg. 2007; 15:682Y94.
36. Strum GM, Friedman MJ, Fox JM, et al. Acute anterior cruciate ligament reconstruction. Analysis of complications. Clin. Orthop. Relat. Res. 1990: 184Y9.
37. Fernandes TL, Fregni F, Weaver K, et al. The influence of femoral tunnel position in single-bundle ACL reconstruction on functional outcomes and return to sports. Knee Surg. Sports Traumatol. Arthrosc. 2014; 22:97Y103.
38. Mae T, Shino K, Miyama T, Shinjo H, Ochi T, Yoshikawa H, Fujie H: Single- versus two-femoral socket anterior cruciate ligament reconstruction technique: Biomechanical analysis using a robotic simulator. Arthroscopy 2001, 17:708-716.
39. Abramowitch SD, Papageorgiou CD, Withrow JD, Gilbert TW, Woo SL: The effect of initial graft tension on the biomechanical properties of a healing ACL replacement graft: a study in goats. J Orthop Res 2003, 21:708-715.
40. Nicholas SJ, D'Amato MJ, Mullaney MJ, Tyler TF, Kolstad K, McHugh MP: A prospectively randomized double-blind study on the effect of initial graft tension on knee stability after anterior cruciate ligament reconstruction. Am J Sports Med 2004, 32:1881-1886
41. .Shelbourne KD, Nitz P: Accelerated rehabilitation after anterior cruciate ligament reconstruction. Am J Sports Med 1990, 18(3):292-299
42. Cascio BM, Culp L, Cosgarea AJ. Return to play after anterior cruciate ligament reconstruction. Clin. Sports Med. 2004; 23:395Y408, ix.
43. Delay BS, Smolinski RJ, Wind WM, Bowman DS. Current practices and opinions in ACL reconstruction and rehabilitation: results of a survey of the American Orthopaedic Society for Sports Medicine. Am. J. Knee Surg. 2001; 14:85Y91.
44. Adachi N, Ochi M, Uchio Y, Iwasa J, Kuriwaka M, Ito Y: Reconstruction of the anterior cruciate ligament. Single- versus doublebundle multistranded hamstring tendons. J Bone Joint Surg Br 2004, 86:515-520
45. Bellier G, Christel P, Colombet P, Djian P, Franceschi JP, Sbihi A: Double-stranded hamstring graft for anterior cruciate ligament reconstruction7. Arthroscopy 2004, 20:890-894.
46. Yasuda K, Kondo E, Ichiyama H, Kitamura N, Tanabe Y, Tohyama H, Minami A: Anatomic reconstruction of the anteromedial and posterolateral bundles of the anterior cruciate ligament using hamstring tendon grafts. Arthroscopy 2004, 20:1015-1025.
47. Zelle BA, Brucker PU, Feng MT, Fu FH: Anatomical double-bundle anterior cruciate ligament reconstruction. Sports Med 2006, 36:99-108
48. Yagi M, Wong EK, Kanamori A, Debski RE, Fu FH, Woo SL: Biomechanical analysis of an anatomic anterior cruciate ligament reconstruction. Am J Sports Med 2002, 30:660-666
49. Shelbourne KD, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. J. Orthop. Sports Phys. Ther. 1992; 15:256Y64.
50. Beynnon BD, Johnson RJ, Abate JA, et al. Treatment of anterior cruciate ligament injuries, part I. Am. J. Sports Med. 2005; 33:1579Y602.
51. Schilaty ND, Nagelli C, Hewett TE. Use of objective neurocognitive measures to assess the psychological states that influence return to sport following injury. Sports Med. 2016; 46:299Y303.
52. Kvist J, Ek A, Sporrstedt K, Good L. Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction. Knee Surg. Sports Traumatol. Arthrosc. 2005; 13:393Y7.
53. Webster KE, Feller JA, Lambros C. Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. Phys. Ther. Sport. 2008; 9:9Y15
54. MARS Group; Wright RW, Huston LJ, et al. Descriptive epidemiology of the Multicenter ACL Revision Study (MARS) cohort. Am. J. Sports Med. 2010; 38:1979Y86.

55. Whitehead TS. Failure of anterior cruciate ligament reconstruction. Clin. Sports Med. 2013; 32:177Y204.
56. Nagelli CV, Hewett TE. Should return to sport be delayed until 2 years after anterior cruciate ligament reconstruction? Biological and functional considerations. Sports Med. 2017; 47:221Y32.
57. Whitehead TS. Failure of anterior cruciate ligament reconstruction. Clin. Sports Med. 2013; 32:177Y204.
58. Nagelli CV, Hewett TE. Should return to sport be delayed until 2 years after anterior cruciate ligament reconstruction? Biological and functional considerations. Sports Med. 2017; 47:221Y32.
59. MARS Group; Wright RW, Huston LJ, et al. Descriptive epidemiology of the Multicenter ACL Revision Study (MARS) cohort. Am. J. Sports Med. 2010; 38:1979Y86
60. Whitehead TS. Failure of anterior cruciate ligament reconstruction. Clin. Sports Med. 2013; 32:177Y204.
61. Kaeding CC, Aros B, Pedroza A, et al. Allograft versus autograft anterior cruciate ligament reconstruction: predictors of failure from a MOON prospective longitudinal cohort. Sports Health. 2011; 3:73Y81.
62. Whitehead TS. Failure of anterior cruciate ligament reconstruction. Clin. Sports Med. 2013; 32:177Y204
63. Walde´n M, Ha¨gglund M, Magnusson H, Ekstrand J. ACL injuries in men's professional football: a 15-year prospective study on time trends and returnto-play rates reveals only 65% of players still play at the top level 3 years after ACL rupture. Br. J. Sports Med. 2016; 50:744Y50.
64. Whitehead TS. Failure of anterior cruciate ligament reconstruction. Clin. Sports Med. 2013; 32:177Y204.
65. MARS Group; Wright RW, Huston LJ, et al. Descriptive epidemiology of the Multicenter ACL Revision Study (MARS) cohort. Am. J. Sports Med. 2010; 38:1979Y86.
66. Nishimori M, Deie M, Adachi N, et al. Articular cartilage injury of the posterior lateral tibial plateau associated with acute anterior cruciate ligament injury. Knee Surg. Sports Traumatol. Arthrosc. 2008; 16:270Y4.

Primary Osteoarthritis Knee: establishing its cause, pathogenesis and treatment -A Prospective Case-Control Study

Agrawal R C

Abstract

Background: The objectives of this analytical study were to compare two scores, Western Ontario McMaster Universities Osteoarthritis Index (WOMAC), Euroqol Group Health Status Score through Visual Analog Scale (EQVAS); Deficient Full Flexion (DFF) and Deficient Full Extension of knee at the beginning and end-point in two, Trial (G1) and Control (G2) groups of Primary Osteoarthritis Knee patients.

Material and Methods: In this study total patients were 125, in G1 - 100 and in G2 – 25. G1 group received hypothesized treatment, contracture correction therapy (CCT) while G2 did no therapy. WOMAC determination done by the questionnaire; EQVAS by vertical-scale and deficiencies by goniometer at 0, 6, 12 and 24 weeks. The CCT consisted of eight body postures, aimed to provide passive flexion or passive extension.

Results: The CCT receiving was associated with recovery (P 0.00) while non-receiving with deterioration (P 0.00). In G1, WOMAC improved: 71.70 to 3.68 and EQVAS 22.25 to 91.55 (P 0.00). In G2, WOMAC deteriorated score worsened from 53.00 to 71.88 and EQVAS 58.60 to 11.96 (P 0.00). DFF and DFE showed coinciding changes.

Conclusion: The cause, pathogenesis and treatment are deficient full flexion/deficient full extension; capsular contracture formation and passive flexion or passive extension respectively.

Keywords: Knee Osteoarthritis, Arthroplasty, Deficient Full Flexion, Deficient Full Extension, Contracture Correction Therapy.

Address of correspondence:
Dr. RC Agrawal
H-805, Purva Fountain Square,
Marathahalli, Bangalore 560037

Email- radhacharan@gmail.com

How to site this article:
Agrawal R C: Primary Osteoarthritis Knee: establishing its cause, pathogenesis and treatment. Orthop J MPC. 2022;28(1):36-43
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/142

Introduction

Primary osteoarthritis knee (OA Knee) is also known as degenerative disease or age-related arthritis. It is found in both the sexes, all over the world and existing since ages. It starts as pain in the knee at about 30 yrs without any evident cause. Pain occurs on joint movement and subsides on rest. Disease progresses over a period of 10-15 yrs when its signs develop at >50 yrs (clinical plus radiographic criteria developed by American College of Rheumatology)1. Despite the age in diagnostic criteria >50, it occurs in adults also- "OA Knee (pain with x-ray evidence) occurs in 12% of persons age ≥60 in United States and 6% of all adults age ≥302. As per the literature, its etiology and pathogenesis are not known- "The exact mechanism for the development of primary OA remains unknown and it is therefore termed idiopathic3. The basic lesion described is degeneration (weakening) of the articular cartilages which progresses with age and aggravates by obesity, diabetes and heredity. OA knee occurs more in those who work in standing or squatting position 4. There are many treatments being used for this disease which are as follows-

A. Non-surgical

1. Physiotherapy, Assistive devices Heat, Electricity5, USG, Laser, Cane, Knee-sleeve

2. Medication NSAIDS, Paracetamol
3. Intra-articular injections1 Hyaluronic Acid, Corticosteroids, Stem cells etc.

B. Surgical

Total knee Arthroplasty (TKA)6,7, Knee Joint Distraction8

There is no cure to this disease9. The treatment is based on pain management and mobility restrictions. All the patients are initially treated with one or more non-surgical options which work for some time. Surgery is advised on failure of this regimen. The most relied operation at present is TKA6,7. This has its own disadvantage as it works for only 15-20 yrs6. So, the question arises what is the specific treatment?

The available literature lacks precise knowledge of its causes, pathogenesis & treatment. This article aims to establish the same and assess the results by a Randomized Controlled Trial (RCT). The hypothesized causes are DFF/DFE/both; pathogenesis is contracture formation in front/back of the capsule and treatment, passive flexion/passive extension knee (CCT). The treatment differs as per the cause & site of contracture.

Material and Methods

2.1. Subjects

The total participants included 125 patients (250 joints) of OA Knee. The G1 included 100 and G2, 25. This number depended upon their scanty availability in my setup. Their inclusion criteria consisted of

1. Age 30 to 85 years
2. Knee pain which appeared without any apparent cause, exacerbated by exertion and subsided on rest
3. Limited morning stiffness
4. No past H/O infection, trauma or inflammation (to rule out secondary OA) and
5. Disability in sitting, climbing stairs or walking. The exclusion criteria consisted of
6. Backache
7. Leg pain (e.g. sciatica)
8. Inability to lie supine (e.g. kyphosis)
9. Inability to lie prone (e.g. central obesity)

Exclusion was based on patients' inability to lie supine and prone, required for the intervention. This trial was based on "Pragmatic Cluster Randomized Controlled Trial", also known as Cluster Randomized Trial (CRT)13 or Group Randomized Trial. In this variety pre-existing groups, called clusters, of individuals are randomly allocated to treatment arms. CRTs can be used when individual randomization to treatment arm is not possible or the intervention is naturally applied to whole cluster. My patients, who consulted me, were of two types. The type I wanted to avoid surgery, had tried other non-surgical options (e.g. drugs, physiotherapy, and intra-articular injections) and did not want those anymore. In such a situation it was not possible to give them any other intervention except the CCT. So those were included in the trial group. The type II were already using some options and living with disabilities but not convinced to receive CCT. So those were included in control group with "no intervention".

The proof of control group as valid pre-existing cluster was obtained by following formula:

All primary OA Knee patients = Pre-existing subjects valid for trial
OR
One patient X n (imaginary number) = Pre-existing subjects valid for trial
OR
1 patient X 28 cluster* = Pre-existing subjects valid for trial
OR
All 28 patients cluster = Pre-existing subjects valid for trial hence
My control group (G_2) = Pre-existing subjects valid for trial
The randomization was non-blinding as CCT was unmaskable

2.2. Procedure

The study setting consisted of my clinic, one charitable hospital, free weekly health camps and clinics of two colleagues. The study period was March 2017 - December 2017. This ten month period gave sufficient time of six months for follow up. Informed consent was sought from all patients. The patients with bilateral affection were investigated and

treated simultaneously. The procedure consisted of

1. Baseline Data Recording
2. Intervention
3. Data Collection and Monitoring.

2.2.1. Baseline Data Recording

It consisted of recording name, age, sex, complaints, side of affected knee, difficulty in sitting, climbing, walking, history of swelling, crackling sound, lurching, deformity, past history of injury/infection, pain in small joints and local examination of affected knee for flexion deformity or bow-knee (genu varum). Skiagrams taken in standing position and radiological grades (I, II, III, and IV) were decided.

The physical examination within the baseline data recording consisted of physical signs elicitation and calculations with measurements.

Only 28 patients fulfilled inclusion criteria with no consent for CCT, the value of n was 28.

Physical signs (author designed):

Fig. 1 Hand insinuation sign

1. Inability to sit on soles (indicative of DFF) – Yes/No
2. Palpable crepitus (first and diagnostic sign of OA knee) – Yes/No
3. Hand insinuation (indicates DFE), Fig. 1 – Yes/No

Calculations and Measurements:

1. WOMAC osteoarthritis score14 (0-96, 96 meant worst) on 5-point Likert-type scale
2. EQ VAS health status score15 (0-100, 100 meant best) by vertical 20 cm scale
3. DFF/DFE/both – these were measured by goniometry. Normal Range of Motion (ROM) of knee was taken to be 0º to 145º. Their details are as below:

a) DFF = ROM 0º to < 145º
b) DFE = ROM > 0º to 145º
c) Both DFF and DFE = ROM > 0º to < 145º

All the Baseline data recording, measurements and CCT treatments were done by corresponding investigators only.

2.2.2. Intervention

This is the designed specific treatment of OA knee which works by providing passive flexion or passive extension. It consisted of following eight body postures-

Posture 1. Full knee flexion in supine

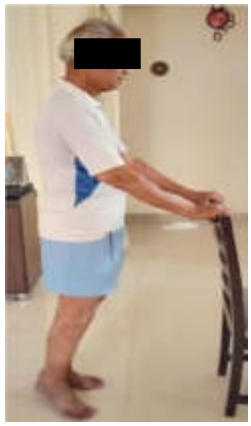
Posture 2. Knee flexion in prone

Posture 3. Full knee flexion by sitting on buttocks

Posture 4. Full knee flexion by sitting on legs

Posture 5. Full knee flexion by sitting on soles

Posture 6. Extension knee in Supine



Posture 7. Extension knee by sitting on buttocks

Posture 8. Extension knee by standing on toes

The first five postures (Fig.2-6) were used in DFF and last three (Fig.6-8) in DFE. Every patient was taught to adopt each posture for 20 slow counts (20 secs/20") twice daily. The sequence of postures was adhered to without applying any force to achieve a high degree of flexion or extension. After each posture, relaxation was permitted by lying flat on back or abdomen for 10 sec. At the outset the therapy was contraindicated in presence of severe pain when oral NSAIDS with rest were given for 5-7days prior to CCT. The duration for posture 2(Fig.3) was 10 sec twice daily. In the initial stage for DFF postures 1&2 (Fig.2&3) and for DFE posture 6(Fig.7) sufficed. Later, if required for DFF postures 3, 4 or 5 (Fig.4, 5, 6) and for DFE postures 7, 8 (Fig.8) were considered. The therapy was taken by the patient as advised and supervised by investigator in weekly visits. Along with this therapy, light physical exercise e.g. walking and taking deep breath (minimum 5 times) were advised for general health.

2.2.3. Data Collection and Monitoring

The monitoring was done during weekly visits and phone conversations. The data were collected at 0,6,12 and 24 weeks by the corresponding investigator.

2.3. Outcome Measures

To assess the results, the primary outcome measure consisted of WOMAC14 and secondary outcome measures consisted of EQ VAS15 score, DFF and DFE at the beginning and end of the follow up. These measures were also used to compare the results between G1 and G2.

2.4. Statistical Analysis

The statistical analyses were performed using IBM **SPSS** Statistics **Version-26.** Paired t-test was used to compare the clinical scores of WOMAC, EQ VAS, DFF and DFE at baseline and endpoints while Independent t-test for comparing final outcome data between G1 and G2. The value of $P<0.05$ was considered statistically significant. For the quantitative data mean tested for two groups using Independent t test while for the categorical and nominal data we applied Chi-square test of association.

Results

A CONSORT (CON=consolidated, S=Standards, O=Of, R=Reporting, T=Trials) chart has been presented for the trial - Fig.9

The incidence of various ways of spending time (occupation) and professions including- 1. Walking and standing (e. g. doctors, nurses and teachers) 2. Squatting and sitting with folded legs (e.g. some shop-keepers and home confined elderly) and 3. Sitting on chair (e.g. table workers) in G1 was 64 (64%), 28 (28%) and 8 (8%) respectively while the same in G2 was 19 (76%), 5 (20%) and 1 (4%).

The incidence of some important features (in G1) consisted of obesity 22 (22%), Diabetes 7 (7%), Grades of OA I-55 (55%), II-4 (4%), III-4 (4%) and IV-7 (7%).

The incidence of various physical signs of knee including 1. Inability to sit on soles, 2. Presence of crepitus and 3. Hand insinuation in G1 was 76 (76%), 75 (75%), and 31 (31%) respectively, while the same in G2 was 16 (64%), 5 (20%), and 6 (24%).

The incidence of various measurable Knee Movement Deficiencies including -1. DFF, 2. DFE, 3. Both DFF and DFE and 4. None in G1 (n=200 knees) was 120 (60%), 50 (25%), 6 (3%) and 24 (12%) respectively while the same in G2 (n=50) was 33 (66%), 11 (22%), 0 (0%) and 6 (12%).

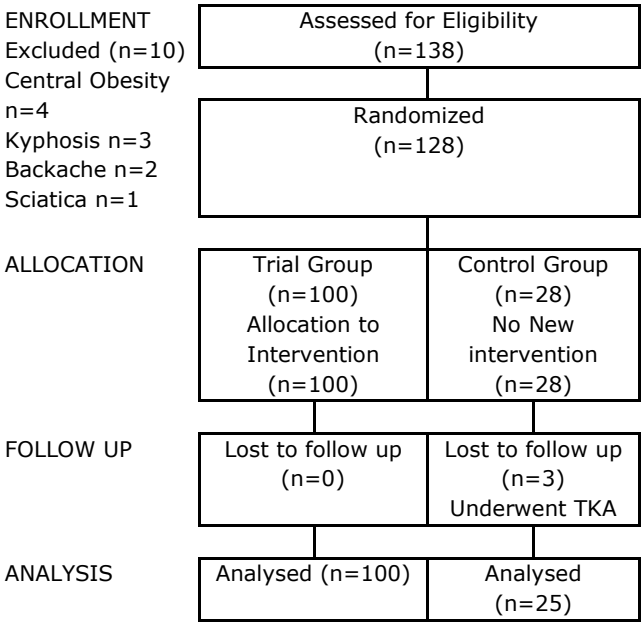


Fig.9 CONSORT Chart

The patients did not differ much in basic demographic and clinical data in two groups (Table1).

Table 1: Some baseline characteristics of OA knee in both groups

S. No	Name of Characteristics		Trial (n=100)	Control (n=25)	P value
1.	Age in years		57 Range 30-85	68 Range 50-85	<0.005
2.	Gender	Male	42 (42%)	16 (64%)	0.048
		Female	58 (58%)	9 (36%)	
3.	Disease Extent	Bilateral	66 (66%)	18 (72%)	0.56
		Right	34 (34%)	7 (28%)	
4.	Duration (in months)		29.8 Range 1-120	66 Range 6-180	0.000

In the statistical analysis all four outcome measures at the baseline were compared with those at the end point (Paired t- test). There was significant improvement in G1 (P-.00) while deterioration in G2 (P-.00). See Table 2.

Table 2: Details of clinical score results in both groups at initial and endpoints

S. No.	Outcome Measures	Trial Group			Control Group		
		0 weeks	24 weeks	P value	0 weeks	24 weeks	P value
1	WOMAC	71.70	3.68	.00	53.00	71.88	.00
2	EQ VAS	22.25	91.55	.00	58.60	11.96	.00
3	DFF	10.71°	.00°	.00	9.74°	14.47°	.00
4	DFE	10.97°	.00°	.00	9.29°	10.71°	.00

The improvement was indicated by decrease in WOMAC, DFF and DFE; by increasing EQ VAS while opposite changes in case of worsening. The comparison of final outcome scores between two groups (Independent t-test) also showed significant difference (Table 3)

Table 3: Comparison of Final Outcome Scores between Trial and Control Groups

S. No.	Outcome Measures	Trial Group			Control Group		
		0 weeks	24 weeks	P value	0 weeks	24 weeks	P value
1	WOMAC	71.70	3.68	.00	53.00	71.88	.00
2	EQ VAS	22.25	91.55	.00	58.60	11.96	.00
3	DFF	10.71°	.00°	.00	9.74°	14.47°	.00
4	DFE	10.97°	.00°	.00	9.29°	10.71°	.00

The data recorded at six and twelve weeks in G1, WOMAC 16.90 and 7.90; EQVAS 65.32 and 88.89; DFF 1.7° and 0.1°; DFE 2.5° and 0.00°. The similar data in G2 consisted of 64.52 and 89; 33.80 and 21.40; 9.6° and 12.8°; 9.2° and 10.9° respectively. The clinical improvement in G1 patients was far superior to that in G2 (Table 4)

Table 4: Treatment Results Analysis

S. No.	Result	Trial Group (n=100)		Control Group (n=25)	
		No. of Patients	Remarks	No. of Patients	Remarks
1	Full Relief	98 (98%)	-	2 (8%)	By exercises and drugs
2	Partial Relief	2 (2%)	Pain subsided; deformity persisted	-	-
3	No Relief	-	-	15 (60%)	-
4	Complications	NIL	-	8 (32%)	Deformity and pain worsened

Discussion

The hypothesis was regarding three parts of OA, viz cause, pathogenesis and treatment. Out of these, treatment was proved through experiment while other two by deducing from its result. When the passive flexion/passive extension as treatment was found to be effective, the related cause and pathogenesis were presumed to be proved.

Synovium is non innervated thin lining of capsule & secretes synovial fluid which traverses from periphery to all around cartilages. Its speed is increased by mutual movements between femur and tibia16. Cartilages are devoid of blood vessels and sensory nerves17, unable to regenerate & conduct pain sensation from knee to brain. They receive their supplies through synovial fluid only. These anatomical facts show that the articular cartilage cannot be the seat of this disease, as it is insensitive to pain. The pain in the condition develops only on joint movement which indicate that responsible structure must be capable of undergoing momentary structural change. This criterion is fulfilled only by the joint capsule.

A body structure, due to any cause, when does not perform its function, loses its functional capacity. For example, the uterus after menopause cannot conceive, knee kept in a plaster cast for some time cannot flex soon exhibiting DFF and shortening anterior part of capsule (Table 5) and an immobilized elbow in semi flexed position neither can fully flex nor extend soon after plaster removal.

Inferences:

- Denied 140° flexion caused 140° of DFF.
- Denied degree of flexion = degree of DFF
- Denied flexion is a functional anomaly represented by DFF
- 140° of DFF caused 7.5 cms shortening in anterior capsule.
- It indicates that pathogenesis is contracture formation in capsule due to DFF. As per literature any knee anomaly produces OA Knee often after many years18.

After plaster removal patient regains full flexion by folding knee itself repeatedly, which meant that passive flexion removed the DFF. Similar event was related to the DFE which was removed by passive extension. Thus passive flexion & passive extension are the methods of treatment of DFF and DFE respectively. For hypothesis summary see Fig.10

Improved outcome measures indicate that the unknown factors (causes, pathogenesis and treatment) are discovered & the hypothesis proven (Table 6).

Limitation in this study: The G2 was smaller than G1 due to unavailability of patients fulfilling the inclusion criteria. To the best of my knowledge, this is second study of its kind, first one11 was also conducted by me. The present study is much improved in form of an RCT. As regards the comparison of results in literature Heidari4 has described the incidence of OA Knee to be more in those who work in standing or those who work in squatting. In the present study first group coincided with patients having DFF & second those with DFE. Incidence in first was 60 (60%), in second 28 (28%) but only 12 (12%) in rest. The later observation is coinciding with the former.

Table 5: Showing relation among Denied Knee Flexion, DFF & Length of Anterior Capsule

Knee	**Denied Flexion**	**ROM**	**DFF**	**Length of Femur shaft & Anterior Knee Capsule* (in cms)**	
				Full Flexion	**Full Extension**
Normal	Nil	0° – 145°	Nil	66†	58.5
Plastered (with 50flexion)	140°	0° – 05°	140°	58.5	58.5

*Presumed to be the distance between anterior superior iliac spine and tibial tuberosity

†Measurement of anterior capsule, in full flexion, was taken in unaffected contralateral leg

The hypothesized treatment (CCT) looks superior to those described in literature.

There is a drawback in this therapy that the elongation in the contracture is short lived which necessitates its frequent sessions. The steps of this therapy look imitation of physiotherapy and exercises which undermine their impression. The future research should be directed to obtain permanent/long-lasting corrections of the contracture so the CCT may not be a lifelong necessity. Other field of research will be to design a lifestyle which will prevent the disease automatically. At present, according to literature the cause and specific treatment of this disease are not known. The results of this study will remove this lacuna.

Table 6: Showing important aspects of Results

S.No.	Result Summary	Interpretation	Significance	Whether proves hypothesis
1.	↓ *WOMAC score(71.70 to3.68)	Decreased score signifies measurable improvement	Quantitative proof of cure[14]	Yes
2.	↑ *EQ VAS score(22.25 to 91.55)	Increased score signifies measurable improvement	Quantitative proof of cure[15]	Yes
3.	Abolished- DFF Initial-10.71° Final-.00°	Average flexion increased from 134.29° to145° by passive knee flexion through anterior contracture correction	Proof of cause removal	Yes
4.	Abolished-DFE Initial-10.97° Final-.0°	Average extension increased from 10.97° to 0° by passive knee extension through posterior contracture correction	Proof of cause removal	Yes
5.	Relief in symptoms (Table 4) **A.** G1- full relief-98 (98%) Partial relief-2 (2%) Complication- nil **B.** G2- Full relief-2 (8%) Partial relief-nil No relief-15 (60%) Complications-8 (32%)	CCT cured a large percentage of patients. Non CCT cured in much less percentage of patients	Proof that CCT is specific treatment Proof that non CCT was almost ineffective	Yes Yes

The addition of these facts will enhance the knowledge of disease and improve its treatments. By the results of this study, there can be vast change in the clinical practice. So far, the disease being treated by orthopaedic & general surgeons, physiotherapist and quacks by various surgical operations, medicines, and devices without unfounded basis. Now the treatment shall be easy and would be carried out by orthopaedic & general surgeons and even by general medical practitioners.

Conclusions

- Cause of Primary Osteoarthritis Knee in a patient is prolonged Deficient Full Flexion /Deficient Full Extension or both.
- Pathogenesis of Osteoarthritis Knee is formation of contracture in joint capsule. The contracture forms in front when cause is DFF and in back when cause is DFE.
- The treatment of Primary Osteoarthritis Knee is passive flexion when cause is DFF, passive extension when cause is DFE and both when causes are combined.

Sources of Support - This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors **Competing Interests statement** - No conflict of interests

Submission declaration – This work11 has been published previously which is now a 'redundant publication'.

Informed consent was obtained from each patient.

Obtained permissions for use of following copyrighted material

a. WOMAC Osteoarthritis Index14
b. EQVAS scale15
c. Indian Journal of Physiotherapy and Occupational Therapy11

References

1. Michelle J Lespasio, Nicolas S Piuzzi, M Elain Husni, George F Muschler, AJ Guarino, Michael A Mont. Knee Osteoarthritis: A Primer. Perm J.2017;21:16-183.

2. Felson David T, Neogi T. Osteoarthritis. In: Jamson, Fauci, Kasper, Hauser, Longo, Loscalzo. editors. Harrison's Principles of Internal Medicine. Vol 2. 20th ed. New York: Mc Graw Hill Education; 2018.p.2624-30.
3. Khanduja V, Khan S W. Hip and knee. In: Williams Norman S, O'connell Ronan P, Mc Caskie Andrew W, editors. Baily & Love's Short Practice of Surgery, Vol 1, 27th ed. Great Britain: CRC Press; 2018.p.513.
4. Heidari Behzad, Knee Osteoarthritis prevalence, risk factors, pathogenesis & clinical features: Part I. Caspian J Intern Med. 2011 Spring; 2(2): 205-212.
5. Cherian JJ, Jauregui JJ, Leichliter AK, Elmallah RK, Bhave A, Mont MA. The effects of various physical non-operative modalities on the pain in osteoarthritis of knee. Bone Joint J.2016 Jan; 98B (1 Suppl A): 89-94.
6. Mihalko William M. In: Azar Frederick M, Beaty James H, Canale Terry S. editors. Campbell's Operative Orthopedics, Vol 1, 13th ed. Philadelphia: Elsevier; 2017.p. 41320.
7. Vaishya R, Vijay V, Agarwal AK. Total Knee Arthroplasty using patient specific blocks after prior femoral fracture without hardware removal. Indian J Orthop 2018;52:154-60.
8. Van der Woude J.A.D. Wiegant K. Heerwaarden van R.J. Struijt S Emans P.J. Mastheegen S.C. et al. Knee joint distraction compared with total knee arthroplasty. A Randomised Controlled Trial: Bone Joint J 2017;99-B:5-8.
9. Heidari Behzad, Knee Osteoarthritis diagnosis, treatment and associated factors of progression: part II Caspian J Intern Med.2011 Summer; 2(3): 249–55.
10. Dhaliwal U, Writing Aim and Objectives: Getting Clarity. In: Gupta P, Singh N. How to Write the Thesis and Thesis Protocol: A primer for Medical, Dental and Nursing Courses. First ed. Delhi: Jaypee Brothers Medical Publishers (P) Ltd. 2014. p.64.
11. Agrawal RC, Trial of a treatment on the patients of Primary Osteoarthritis Knee, Indian Journal of Physiotherapy and Occupational Therapy 2016;10:185-90.
12. Joshi M. Selecting the Research Design. In: Gupta P, Singh N editors. How to Write the Thesis and Thesis Protocol: A primer for Medical, Dental and Nursing Courses. First ed. Delhi: Jaypee Brothers Medical Publishers (P) Ltd.2014. p.33.
13. Clustered Randomized Trials. https://www.qmul.ac.uk> research (date last accessed 30 August 2020).
14. WOMAC Osteoarthritis Index (Lk3.1). https://www.xediton.com>GO-ON-Knee-orHip-WOMAC.pdf (date last accessed 30 August 2020).
15. Mandy Van Reenen / Bas Janseen. preparators. EQ-5D-5L User Guide: Basic information on how to use the EQ-5D-5L instrument; Version 2.1 April 2015.
16. Bulstrode CJK. Diseases of bone and joints: generalised diseases and chronic joint disorders. In: Russell RCG, Williams NS, Bulstrode CJK. editors. Baily & Love's Short Practice of Surgery, London: Arnold; 2000. p.415.
17. Caroline W, Adams Michael A. Functional Anatomy of the Musculoskeletal system. In: Standring S, Borley Neil R, Collins P, Crossman Alan R, Gatzoulis Micheal A, Healy Jeramiah C et al. editors. Gray's Anatomy, The Anatomical Basis of Clinical Practice. 40th ed. Elsevier: Churchill Livingstone; 2008. p.99.
18. Hamblen David L, Simpson RW Hamish A. editors. Osteoarthritis (Degenerative Arthritis; arthrosis; osteoarthrosis; hypertrophic arthritis; post-traumatic arthritis). In:
19. Adams's Outline of Orthopaedics.14thed.Edinburgh: Churchill Livingstone;2010. p.140.
20. Ralstone S.H, McInnes I.B. Rheumatology and bone diseases. In: Walker Brian R, Colledge Nicki R, Ralston Stuart H, Penman Ian D. editors. Davidson's Principles and Practice of Medicine, 22nd ed. Edinburgh: Churchill Livingstone; 2014. p.1082.

Clinical and functional outcome of uncemented total hip replacement in patients with avascular necrosis of femoral head

Singh V, Bhinde S, Patidar A, Jain S, Sharma SK

Study performed at Department of orthopaedics, R. D. Gardi Medical College, Ujjain, MP

Abstract

Background: Avascular necrosis of femoral head is a common problem. New cases are now a days diagnosed early and treated early, because of Ayushman bharat yojna. It mostly affects the femoral head (hip joint). Its management can be conservative or invasive. [1-4]. Total hip arthroplasty is the treatment of choice for third and fourth stage avascular necrosis [5-8].

Material & Method: Fifty patients of Avascular necrosis of femoral head of stage III and IV are operated by uncemented total hip arthroplasty and their results were assessed by Harris hip score.

Results: The mean Harris hip score during preoperative stage was 33.27 and during postoperative stage was 91.60. Excellent results are seen in 44 patients, good results are seen in 6 patients, poor or very poor results are seen in none patients.

Conclusion: Current generation of uncemented implants provide satisfactory clinical and radiographic outcomes in intermediate duration of follow up in avn of hip.

Keywords: Avascular necrosis of femoral head, uncemented total hip arthroplasty

Address of correspondence
Dr Vivek Singh
Professor & Unit head, Department of Orthopaedics, R. D. Gardi Medical College, Ujjain

Email-drviveksingh29@rediffmail.com

How to site this article
Singh V, Bhinde S, Patidar A, Jain S, Sharma SK
Clinical and functional outcome of uncemented total hip replacement in patients with avascular necrosis of femoral head, Orthop J MPC. 2022;28(1):44-47
Available from:
https://ojmpc.com/index.php/ojmpc/article/view/154

Introduction

Incidence of AVN of femoral head is increasing, approximately 15,000 to 30,000 new cases occur annually in the USA. In India as there is no statistical data available, considering the population around 1.3 billion approximately 70000 to 90,000 patients get affected with AVN [1-2]. The disease occurrence is more in men than in women. Avascular necrosis is a disease where there is cellular death of bone components due to interruption of the blood supply. If avascular necrosis involves the bones of a joint, it often leads to destruction of the joint articular surface followed by secondary osteoarthritic changes in the hip [3-5]. Total hip arthroplasty is the only effective treatment of AVN of the femoral head when the disease process has reached Ficat and Arlet stages III and IV [6-8].

Cementless total hip arthroplasty remains a reasonable treatment option for advanced osteonecrosis of the femoral head. Avascular necrosis occurs due to impaired blood supply to the bone. It can be caused by fractures, dislocations, chronic steroid use, chronic alcohol use, coagulopathy, congenital source, and many other factors.

The purpose of this study is to assess the clinical functional outcomes of cementless total hip arthroplasty in patients with avascular necrosis of the hip. Aims and objectives of the study are, how early the patients recover from avascular necrosis of femoral head in arthritis stage following uncemented total hip arthroplasty and to study the clinical and functional outcome of uncemented total hip replacements in patients with avascular necrosis of femoral head.

Material and Method

This prospective study was conducted on patients who had arthritis of hip joints secondary to avascular necrosis of femoral head, during 3-year period from April 2018 to March 2021 in Department of Orthopaedics, R. D. Gardi Medical College, Ujjain. Inclusion criteria was patients of avascular necrosis of femoral head, patients in the age group of less than 60 years and patients willing to give informed consent. Exclusion criteria was patients of age more than 60 years, patients with systemic and local infections and patients who are not medically fit for surgery. Thorough preoperative assessment like history, clinical and radiological examination and routine investigations of the patient done. The patients were evaluated according to the modified Harris hip scoring system both preoperatively and postoperatively [9]. The scores taken into account were of pain, function, range of motion, and deformities.

Also, a mention of the limb length discrepancy and flexion contracture is made. The patients are reviewed with post op x-rays immediately after surgery at the end of 6, 12, 24 weeks after the surgery, then 12-month, 18 month and 2 years. Radiological assessment was done with radiogram of the pelvis with both hips with proximal half of shaft of femur AP view and lateral view was taken for all patients. The radiograph was evaluated for size of the acetabulum, bone stock of the acetabulum, any protrusion and periacetabular osteophyte formation, the structural integrity of the acetabulum, need for bone grafting and size of the femoral canal.

Table 1: Age distribution of patients studied

Age in years	No. of patients	%
21-30	5	10
31-40	26	52
41-50	13	26
51-60	6	12
Total	50	100

Table 2: Harris hip score, preop and post op

	Preop	Post op
Pain	10.13	42.13
Gait	10.53	30.33
Activity	5.17	11.40
Absence of deformity	4.00	4.00
ROM score	2.17	4.63
Total	33.27	91.60

Table 3: Post operative Harris hip Score

Rating	No. of patients	%
Excellent	44	80.0
Good	6	20.0
Poor	0	0
Very poor	0	0
Total	50	100

Table 4: comparison of HHS with other studies.

Study	Number of patients	Post op Mean HHS
Koteshwar et al [20]	30	92
Kakaria et al [21]	20	89
Karimi et al [22]	55	93
Sayed et al [27]	24	85
Our Study	50	91.6

Table 5: Complications

Complications	No. of patients	%
Nil	44	88
Foot drop	1	02
Dislocation	1	02
Superficial infection	2	04
Deep Infection	1	02
Periprosthetic Fracture femur	1	02
Total	50	100

Table 6: Comparison with other studies

Studies	Cemented/ Cementless THR	Follow up in years	Number of cases	Revision Rate %
Salvati et all [23]	Cemented	8	28	37
Kim et al [24]	Cementless	7.2	78	21.8
Piston et al [25]	Cementless	7.5	35	6
Lins et al [26]	Cementless	5	37	8.1
Our study	Cementless	3	50	0

Figure 1 - Preop xray, 35yr/f

Figure 2 – Bilateral THR done

The aim of the templating was to obtain the following results postoperatively an acetabular socket located in the anatomical position, center of

rotation of femoral head located in its normal anatomical position, restoration of limb length and restoration of abductor moment arm. Informed written consent is taken from the patients. All the patients were operated by Posterior (Southern or Moore's) Approach.

Figure 3- Follow up

Figure 4- Follow up

Discussion

This study has shown that, the mean age of patients in the study group was 32.30 years.

About 26 (52%) of the avascular necrosis patients in the study group belonged to 31-40 years age group. In contrary to these findings, a multivariate analysis identified young age at onset of avascular necrosis [10-12] The sex distribution of the study group has shown that, about 42 (84 %)of the patients were Males and 8 (16%) were females. Other studies like Tofferi JK, Gilliland W, also found the same results [12, 14]. The analysis of patients for the etiology of AVN showed that in 42 (84%) of the patient developed AVN of hip joint the cause was idiopathic, 5 (10%) of patients developed AVN secondary to corticosteroid use, and secondary to post trauma 3 (6%)patients developed AVN of the hip joint. In a study by Koo & Kim et al showed, 65% of AVN due to idiopathic cause and 10% to 30% cases due to corticosteroid therapy which is quite similar to this study [13]. In our study, most 22 (44.0%) of the patients of had left hip replacement, 18 (36%) had undergone right total hip replacement and 10 (20%) had undergone bilateral total hip replacement. These results were similar to the findings of Jacobs et al [14]. All of the patients 50 (100%) had uncemented type of arthroplasty. The new generation of uncemented prosthesis had demonstrated improvement in clinical and radiological outcomes compared with those associated with early designs of prosthesis inserted without cement [15]. Pain relief, Functional gait and activity and range of movement Score, all have improved post operatively. Excellent results are seen in 44 (88%) patients, good results are seen in 6 (12%) patients, poor or very poor results are seen in none patients. The mean Harris hip score during preoperative stage was 33.27 and during postoperative stage was 91.60. Almost similar results are seen in other studies [10-16]. In our study group, postoperative limb shortening was not seen in 38 (76%) of the study group. About 4 (8 %) and 3 (6%) patients of our study group had limb shortening of 1 cm and 1.5 cms respectively. Over lengthening of 1 cm is seen in 5 unilateral THR cases and a lengthened limb is more poorly tolerated. Konyves and Bannister noted that lengthened limbs were also associated with lower clinical hip scores[19]. Limb-length discrepancy can result from a poor preoperative patient evaluation as well as intraoperative technical errors with regard to the level of resection of the femoral neck, the prosthetic neck length, or the failure to restore offset. Most 44 (88%) of the patients in the study group had no complications. The common complication in the study group was superficial infection in 2 patients which is 4%. In a study by Meek RM, Garbuz DS [17], intraoperative fracture was observed in 4.3% of hips, sciatic nerve palsy was observed in 1.1%, 14% of the cases were revised because of aseptic loosening. In a study by Learmonth ID showed periprosthetic fracture in 8.6% cases[17,18]

Conclusion

Total hip arthroplasty is a well-documented surgical procedure for AVN hip. It relieves pain and functional disability of patients with arthritis of the hip, secondary to AVN and improving their quality of life. The outcome of the THR of hip joint is determined the design of component, the selection of the patients, and the operative technique. The results of the procedure needs long term studies for evaluating the complete effect. Current generation of uncemented implants provide satisfactory clinical and radiographic outcomes in intermediate duration of follow up. Even

though the procedure is not free of complications, the overall functional and clinical outcome had shown good to excellent result. In future, cases of AVN hip may increase because of execessive use of steroids in Covid 19 treatment.

References

1. Lavernia CJ, Sierra RJ, Grieco FR. Osteonecrosis of the femoral head. J Am AcadOrthop Surg. 1999;7(4):250-61.
2. Vail TP, Covington DB. The incidence of osteonecrosis. In: Urbaniak JR, Jones JR, eds. Osteonecrosis: Etiology, Diagnosis, Treatment. Rosemont, Ill: American Academy of Orthopedic Surgeons, 1997, 43-9.
3. eMedicine Specialties > Bone Infarct Author: Ali Nawaz Khan. Coauthors: Mohammed Jassim Al-Salman, Muthusamy Chandramohan, Sumaira MacDonald, Charles Edward Hutchinson.
4. Digiovanni, CW, Patel, A, Calfee, R, Nickisch F. Osteonecrosis in the foot: The Journal of the American Academy of Orthopaedic Surgeons 2007;15(4):208–17.
5. eMedicine Specialties > Avascular Necrosis Author: Jeanne K Tofferi, MD, MPH, FACP; Coauthor: William Gilliland, MD, MPHE, FACP, FACR. Updated, 2009
6. Mont MA, Hungerford DS. Non-traumatic avascular necrosis of the femoral head. J Bone Joint Surg Am. 1995; 77:459.
7. Mont MA,Jones LC,Hungerford DS.Non-traumatic osteonecrosis of the femoral head: Ten years later- current concepts review J Bone Joint Surg Am. 2006;88:1107-29.
8. Steinberg ME. Diagnostic imaging and role of stage and lesion size in determining outcome in osteonecrosis of the femoral head. Tech Orthop. 2001;16:6-15.
9. Harkess JW.Arthroplasty of hip.,Campbells Operative Orthpeadics, Edited by Crenshaw AH, 8th edition, Vol. 1: CV Mosby Company, St. Louis, Washington DC, Torto, 1982.
10. Eftekhar NS. Total hip replacement using principles of lowfriction arthroplasty: The hip surgery of the musculoskeletal system, Edited by CM Evarts, Vol.3: Churchill Livingston, 1983.
11. Steinberg, Marvin E. Osteonecrosis:Merck Manual of Diagnosis and Therapy. Archived from the original on 12 May 2009.
12. Tofferi JK,Gilliland W,Avascular necrosis,available at http:// emedicine.medscape.com/article/333364, updated: Jan 19, 2012. Accessed March 20, 2012.
13. Koo KH, Kim R, Kim YS et al. Risk period for developing osteonecrosis of the femoral head in patients on steroid treatment. ClinRheumatol. 2002;21(4):299-303.
14. Jacobs B. Epidemiology of traumatic and nontraumatic osteonecrosis. Clin Orthop. 1998;130:51-67.
15. Callaghan JJ, Dysart SH, Savory CG. The uncemented porous coated anatomic total hip prosthesis. Two-year results of a prospective consecutive series. J Bone and Joint Surg. 1988; 70-A:337-346.
16. Katz JN, Phillips CB, Baron JA, Fossel AH, Mahomed NN, Barrett J et al. Association of hospital and surgeon volume of total hip replacement with functional status and satisfaction three years following surgery. Arthritis Rheum 2003;48:560– 568.
17. Meek RM, Garbuz DS, Masri BA, Greidanus NV, Duncan CP. Intraoperative fracture of the femur in revision total hip arthroplasty with a diaphyseal fitting stem. J Bone Joint Surg Am. 2004;86:480-5.
18. Learmonth ID. The management of periprosthetic fractures around the femoral stem. J Bone Joint Surg Br. 2004;86:13-9.
19. Konyves A, Bannister GC. The importance of leg length discrepancy after total hip arthroplasty. J Bone Joint Surg Br. 2005;87:155-7.
20. Phillips FM, Pottenger LA, Finn HA, Vandermolen J. Cementless total hip arthroplasty in patients with steroid induced avascular necrosis of the hip. A 62-month follow-up study. ClinOrthopRelat Res. 1994; 303:147-54.

Paediatric Tuberculous spinal abscess causing compression at the lumbar level

Mehta R, Agrawal A, Singh V

Investigation performed at R.D. Gardi Medical College, Ujjain (M.P.)

Abstract

Incidence of paediatric spinal tuberculosis (TB) is increasing. Paediatric spinal TB is known to cause rapid bony destruction and deformity progression. We present a 4-year child with lumbar kyphotic deformity, progressive lower limb weakness and early bladder involvement. Imaging revealed near complete destruction and retropulsion of L4 vertebra with spine at risk signs. Posterior decompression, L1 to S1 fixation with pedicle screws and punching the remaining L4 body ventrally was performed. With aggressive post-operative physiotherapy and AKT patient recovered neurologically from Frankel C to Frankel E grade with complete radiological resolution of disease at final follow-up of 1 year. No further progression of deformity was observed at final follow-up.

Conclusion: Early diagnosis, timely and judicious surgical intervention is the key to management of paediatric spinal TB.

Address of correspondence:
Dr Rahul Mehta
Associate Professor & Department of Orthopaedics, R. D. Gardi Medical College, Ujjain

Email-Drrahulpmehta@gmail.com

How to cite this article:
Mehta R, Agrawal A, Singh V
Paediatric Tuberculous spinal abscess causing compression at the lumbar level Ortho J MPC. 2022; 28 (1):48-49

Available from:
https://ojmpc.com/index.php/ojmpc/article/view/155

Introduction

The incidence of vertebral TB is increasing and it accounts for 10-20% of all extra-pulmonary cases of TB(1). Thoraco-lumbar junction is the most commonly involved site followed by lumbar and cervical region.(2) Spinal TB occurs most commonly in children and young adults(3). Early diagnosis and intervention is required in children as it may lead to bony destruction, deformity of the growing spine and severe neurological complications.

Case Report

A 4yr old female child presented with the complains progressively increasing back pain and bilateral lower limb weakness since 2-3 months, with inability walk or sit without support since last 15 days. Frequency of micturition was increased and constitutional symptoms were present. Neurological status was Frankel grade C.(4)

Pre-op xray suggested of mild lumbar kyphosis with vertebral destruction at multiple levels. MRI and CT scans revealed complete destruction with retropulsion of L4 vertebral body and partial destruction of L2L3L5 vertebra. Spine at risk signs were present hence surgery planned.

Surgical Procedure

Under GA in prone position with all bony prominences well padded. The procedure was performed under C-arm guidance. Midline skin incision given, posterior only approach was used. L3 partial L4 complete Lt. laminectomy with L1-S1 posterior decompression with instrumented fixation (3.5mm pedicle screws)was performed.

Retropulsed L4 fragment was punched ventrally. Customised LS corset was applied and patient was registered for ATT category-1 for 9 months. Patient was followed up and clinical, radiological and haematological assessment was done every 2wks, 6wks, 3months, 6 months till 12 months. At final follow up, patient came walking without

support and neurological recovery was complete (Frankel grade 'E').

There was complete resolution of disease radiologically. Disease healed completely and there was no central compression of dura at L3L4 level.Mild segmental kyphosis still persisted.

Conclusion

Spinal TB requires multidisciplinary team for its management. Early detection, timely and judicious surgical intervention are the key to surgical management and prevention of complications.

Fig 1. Pre-operative MRI

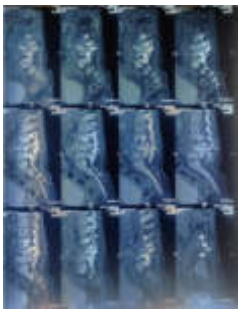


Fig 2. Pre-operative CT

Fig. 3, 4

Fig. 5, 6, 7. Intra op and post op picture

Fig 8-Post operative clinical picture

References

1. Benzagmout, M., Boujraf, S., Chakour, K., & Chaoui, M. E. F. (2011). Pott's disease in children. Surgical neurology international
2. Garg RK, Somvanshi DS. Spinal tuberculosis: a review. J Spinal Cord Med. 2011;34(5):440-54. doi: 10.1179/2045772311Y.0000000023. PMID: 22118251; PMCID: PMC3184481.
3. Teo, H. E., & Peh, W. C. (2004). Skeletal tuberculosis in children. Pediatric radiology, 34(11), 853-860.
4. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH, Vernon JD, Walsh JJ. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. I. Paraplegia. 1969 Nov;7(3):179-92. doi: 10.1038/sc.1969.30. PMID: 5360915.

ORTHOPAEDIC JOURNAL OF M. P. CHAPTER

An official publication of Madhya Pradesh Chapter of Indian Orthopaedic Association

Author Guidelines

Manuscript submitted should be easy to read & edit. Detailed instructions are available on the website www.icmje.org , which gives guidelines for uniform requirements for manuscripts submitted to biomedical Journals.

All manuscripts submitted to the journal must be original research submitted to Orthopaedic Journal of M P Chapter (OJMPC) alone, must not be previously published, already accepted for publication, or under consideration for publication elsewhere, and, if accepted, must not be published elsewhere in similar form, without the consent of editor-in-chief or publisher. All the manuscript submitted to the journal receives individual identification code and would initially be reviewed by the editors then undergoes a formal double blind peer review process before publication.

Article Proof

Manuscripts accepted for publication are copy edited for grammar, punctuation, print style, and format. Page proofs are sent to the corresponding author through e-mail. They must carefully check and return the revised manuscript within 72 hours. It is the responsibility of the corresponding author to ensure that the galley proof is to be returned without delay with correction. In case of any delay, authors are responsible for the contents appeared in their published manuscripts.

Categories of Articles

Article can be sent as Research/Original article, Review article, brief reports, Case report & Letter to editors.

(a) Original article

Original articles should contain original research relevant to Orthpaedics and allied specialties and includes case control studies, cohort studies, interventional studies, experimental study. Text of study is usually divided into sections introduction, methods, Results & Discussion. Manuscripts should be accompanied with an abstract (divided into Background, Methods, Results and Conclusion) in not more than 250 words. Four to five key words in alphabetical order should be provided for indexing along with abstract.

The typical text length for such contribution in 2500-3500 words (excluding Title page, abstract, tables, figures, acknowledgements, & references)

(b) Review Article

Journal encourages submission of review article on topic of general interest. The typical length should be about 3000 words (excluding tables, figures & references) manuscript should be accompanied with Abstract of less than 250 words.

(c) Case Report

Clinical case highlighting uncommon condition or presentation are published as care reports. The Text should not exceed 1000 words & is divided into sections i.e. abstract, Introduction, case report and discussion. Include a brief abstract of about 100 words.

(d) Brief Report

Short account of original studies are published as brief reports. The text should be divided into section i.e. abstract, introduction, methods, results & discussion.

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.

(e) Letter to Editor(s)

The editor welcomes and encourage correspondence relating to articles published in journal. Letter may also relate to other topic of interest to medical professional. Letter should not be more than 300 words.

Preparation of Manuscript

Title: The title of the article should be approximately 10-15 words (this may be changed with the author's approval). The first character in each word in the title has to be capitalized

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.

Tables:

- Tables should be self-explanatory and should not duplicate text material.
- Tables with more than 10 columns and 10 rows are not acceptable.
- Number tables, in Arabic numerals, consecutively in the order of their first citation in the text and supply a brief title for each.
- Place explanatory matter in footnotes, not in the heading.
- Explain in footnotes all non-standard abbreviations that are used in each table.
- Obtain permission for all fully borrowed, adapted, and modified tables and provide a credit line in the footnote.
- For footnotes use the following symbols, in this sequence: *, †, ‡, §, ||,¶ , **, ††, ‡‡
- Tables with their legends should be provided at the end of the text after the references. The tables along with their number place in the text.
- Figures:
- The maximum number of figures should be limited to four.
- Upload the images in JPEG format. The file size should be within 4 MB in size while uploading.
- Figures should be numbered consecutively according to the order in which they have been first cited in the text.
- Labels, numbers, and symbols should be clear and of uniform size.
- Titles and detailed explanations should be written in the legends for illustrations, and not on the illustrations themselves.
- Send digital X-rays, digital images of histopathology slides, where feasible.
- If photographs of individuals are used, authors should take written permission to use the photograph.
- If a figure has been published elsewhere, acknowledge the original source and submit written permission from the copyright a credit line should appear in the legend for such figures.
- If the uploaded images are not of printable quality, the publisher office may request for higher resolution images which can be sent at the time of acceptance of the manuscript. Ensure that the image has minimum resolution of 300 dpi or 1800 x 1600 pixels.
- The Journal reserves the right to crop, rotate, reduce, or enlarge the photographs to an acceptable size.
- Acknowledgments: Limit to 100 words.
- References:
- The references / bibliography should be in Vancouver style. For full details on this refer to the following link to university of Queensland http://www.library.uq.edu.au/training/citation/vancouv.pdf .
- The titles of journals should be abbreviated according to the style used in Index Medicus.
- Use the complete name of the journal for non-indexed journals.
- Avoid using abstracts as references.
- Information from manuscripts submitted but not accepted should be cited in the text as "unpublished observations" with written permission from the source.
- Journal article: list first six author followed by et al. eg (Dumbre Patil SS, Karkamkar SS, Dumbre Patil VS, Patil SS, Ranaware AS. Reverse distal femoral locking compression plate a salvage option in nonunion of proximal femoral fractures. Indian J Orthop 2016;50:374-8)
- Books and Other Monographs

Personal author(s): Ringsven MK, Bond D. Gerontology and leadership skills for nurses. 2nd ed. Albany (NY): Delmar Publishers; 1996.

Editor(s), compiler(s) as author: Norman IJ, Redfern SJ, editors. Mental health care for elderly people. New York: Churchill Livingstone; 1996.

Chapter in a book: Phillips SJ, Whisnant JP. Hypertension and stroke. In: Laragh JH, Brenner BM, editors. Hypertension: pathophysiology, diagnosis, and management. 2nd ed. New York: Raven Press; 1995. pp. 465-78.

..... Lets Live an Active Life !

NUDOLO® Gel

Diclofenac Diethylamine + Linseed Oil +
Methyl Salicylate + Menthol + Capsaicin Gel

When you require a quad force to attack

Nudolo®-Plus

(Bromelain 90mg + Trypsin 48mg + Rutoside 100mg + Diclofenac Sodium 50mg Tablets)

In all types of peripheral neuropathies

Melex®-Plus Capsule

(Mecobalamine, ALA, Folic Acid, B_1 and B_6 Capsule)

Approved by USFDA

In GERD, NUD, Gastritis & Drug Induced Reflux Disease

NURAB®-40 I.V.

(Pantoprazole 40mg I.V.)

Lextra Pharmaceuticals

Let's give Life an extra boost !

www.lextrapharma.com

EDITOR

Dr Vivik Singh

Dept Of Orthopaedics,

R D Gardi Medical College, Ujjain, MP

ASSOCIATION

Indian Orthopaedic Association

CHAPTER

Madhya Pradesh

PUBLISHER

Madhya Pradesh Chapter

of Indian Orthopaedic Association

CORRESPONDENCE

Dr Vivek Singh (Editor)

Email: editor@ojmpc.com

WEBSITE & E-PUBLISH BY

SYSNANO INFOTECH

Web Development, Hosting Servers

(+91)-99931-77-656 (+91)-9977-77-0442

info@sysnano.com www.sysnano.com