

Lower Limb Fractures in the Elderly: Challenges and Perspectives for Optimal Care

Reda El Alami^{1*}, Rhita Salah¹, Mekaoui Jala¹, Boufetal Mouncef¹, Bassir Rida Allah¹, Mohammed Kharmaz¹, Moulay Omar Lamrani¹, Berrada Mohammed Salah¹

¹Department of Orthopaedic Surgery and Trauma IBN SINA Hospital University Mohammed V, Rabat Morocco

DOI: [10.36347/sasjs.2023.v09i08.008](https://doi.org/10.36347/sasjs.2023.v09i08.008)

| Received: 06.07.2023 | Accepted: 11.08.2023 | Published: 21.08.2023

*Corresponding author: Reda El Alami

Department of Orthopaedic Surgery and Trauma IBN SINA Hospital University Mohammed V, Rabat Morocco

Abstract

Original Research Article

This article provides an in-depth examination of complex lower limb fractures in orthopedic and traumatology surgery among the elderly population. It highlights the rising incidence of these fractures, particularly in the elderly, emphasizing the importance of associated risk factors. The article explores current surgical approaches for fixation and rehabilitation of these fractures, while presenting emerging techniques under development, such as robot-assisted surgery and customized implants. The significance of a multidisciplinary approach in care, involving geriatricians, physiotherapists, and nurses, is emphasized to enhance outcomes and reduce postoperative complications. Lastly, the article underscores the importance of awareness and prevention, highlighting initiatives to reduce falls among the elderly and improve bone health.

Keywords: Fractures, Lower limb, Elderly, Orthopedic surgery, Prevention.

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I. INTRODUCTION

a) Introduction to the subject and its importance

Complex fractures of the lower limb in the elderly represent a major challenge for orthopaedic and traumatological surgery. As the population ages, these fractures are becoming a growing concern, due to their increasing incidence and significant impact on patients' quality of life. In this introduction, we will examine the importance of this subject, highlighting the medical, social and economic issues it faces.

Elderly people, especially those over 65, are more prone to fractures of the lower limb due to reduced bone density and increased bone fragility. Fractures of the neck of the femur, the ankle, the tibia and other parts of the lower limb can occur following a simple fall, and often have serious consequences, such as loss of autonomy, permanent disability and even an increased risk of death.

In addition to the impact on patients' health, these fractures also place a considerable burden on healthcare systems and medical resources. Their management often requires complex surgical care, prolonged rehabilitation and careful medical monitoring, resulting in high costs for individuals, families and society as a whole.

Faced with this growing reality, healthcare professionals and researchers are striving to develop innovative, personalized surgical approaches to improve outcomes and quality of life for elderly patients suffering from complex fractures of the lower limb. The introduction of new technologies, advanced materials and rehabilitation protocols specifically adapted to the elderly is a promising way of tackling this challenge.

In this article, we will delve into the heart of this issue by presenting a specific case study of an elderly patient with a complex fracture of the lower limb. We will analyze the different surgical approaches available, drawing on a review of recent literature to highlight the most relevant scientific and clinical advances.

In conclusion, the management of complex fractures of the lower limb in the elderly is an area of orthopaedic and traumatological surgery that requires particular attention. By improving our understanding of risk factors, optimal surgical approaches and suitable rehabilitation methods, we can help improve the quality of life of elderly patients and alleviate the socio-economic burden associated with these fractures. Let's turn now to a case study and literature review to deepen our understanding of this crucial topic [1, 2].

b) Background to the increase in fractures among the elderly

The increase in fractures among the elderly is a major public health concern worldwide. This trend can be explained by a number of interrelated factors, ranging from demographic changes to changes in people's lifestyles.

First and foremost, the aging of the population is a determining factor. Medical advances and improvements in living conditions have contributed to an increase in life expectancy in many countries. As a result, the number of people aged 65 and over has risen considerably in recent decades. This demographic shift means that a higher proportion of people are vulnerable to fractures of the lower limb, as age is a major risk factor for bone fragility.

In addition, the adoption of sedentary lifestyles and lack of physical activity in some elderly people can lead to a reduction in bone density and loss of muscle mass, increasing the risk of fractures in the event of a fall.

Health-related risk factors, such as osteoporosis, balance disorders and chronic diseases, can also contribute to the increased prevalence of fractures in the elderly. Osteoporosis, in particular, weakens bones and makes them more prone to fracture, even with minor trauma.

Moreover, polypharmacy in the elderly, i.e. taking several medications at the same time, can increase the risk of falls and, consequently, fractures.

Finally, the risk of complex fractures of the lower limb in the elderly is exacerbated by external factors such as unsafe home environments, obstacles in public places and adverse weather conditions.

Faced with this worrying increase in fractures among the elderly, healthcare professionals, researchers and policy-makers face a major challenge in developing effective prevention strategies and appropriate treatment approaches. The identification of specific risk factors, the implementation of fall prevention programs and the use of innovative surgical techniques are all promising avenues for improving clinical outcomes and quality of life in elderly patients with complex fractures of the lower limb.

Given this context, it is essential to pursue research and promote a multidisciplinary approach to deal with this growing problem, and it is with this in mind that this case study with literature review in orthopaedic and traumatological surgery takes on its full importance [3, 4].



Figure 1: Fracture in the elderly

c) Aims of the article:

The aim of this article is to deepen our understanding of complex fractures of the lower limb in the elderly in orthopaedic and traumatological surgery. To this end, we have defined the following objectives:

Presenting a specific case study: We will describe in detail an actual case of an elderly patient with a complex fracture of the lower limb. By outlining the patient's medical history, the nature of the fracture and his general state of health, we'll give readers a better understanding of the specific clinical and surgical issues facing elderly patients with these fractures.

Carry out an in-depth literature review: We will conduct a comprehensive analysis of recent studies and research into complex fractures of the lower limb in the elderly. This literature review will enable us to highlight the most relevant medical, surgical and technological advances, as well as the best clinical practices in terms of treatment and post-operative management.

Examine the different surgical approaches: We will evaluate the different surgical approaches available for the treatment of complex fractures of the lower limb in the elderly. We will analyze in detail internal fixation techniques, the use of joint prostheses, bone grafts and other innovative methods, highlighting their respective advantages, limitations and clinical outcomes.

Discuss the specific challenges associated with orthopedic surgery in the elderly: We will address the specific challenges associated with the surgical management of fractures in the elderly, such as bone fragility, intraoperative risks and postoperative complications. We will also explore preventive approaches to reduce the risk of falls and fractures in this vulnerable population.

Highlighting future prospects: We will present technological advances and ongoing research that could transform the management of complex fractures of the

lower limb in the elderly. Looking to the future, we will highlight promising avenues for improving clinical outcomes and quality of life for elderly patients suffering from these fractures.

By bringing these objectives together, we hope that this article will provide in-depth and relevant information to healthcare professionals, researchers and stakeholders involved in the management of fractures in the elderly. By raising awareness of the crucial issues involved, we aspire to contribute to the improvement of care and the development of effective preventive strategies for this growing and vulnerable population.

II. LITERATURE REVIEW

a) Statistics on lower limb fractures in the elderly

A review of the literature concerning statistics on fractures of the lower limb in the elderly reveals a growing worldwide concern. In France, as in many other countries, the aging of the population has led to a significant increase in the number of fractures affecting this vulnerable population.

According to data from Santé Publique France, fractures of the lower limb are one of the main causes of morbidity and loss of independence in people aged 65 and over. Statistics show that femoral neck fractures are among the most frequent, with a higher incidence in women. These fractures are often associated with bone fragility, which is a frequent problem in the elderly and increases the risk of injury even in the event of a slight fall.

Statistics also show that ankle and tibia fractures are also a concern in this population. These fractures can lead to severe pain, reduced mobility and significant difficulties in activities of daily living [5, 6].

Elderly people who have already suffered a fracture of the lower limb have an increased risk of recurrence, underlining the importance of proper management to prevent further injury.

In addition to the medical consequences, statistics also reveal the significant socio-economic impact of fractures in the elderly. These injuries often lead to prolonged hospitalization, stays in convalescent homes and rehabilitation care, placing a heavy burden on healthcare systems and medical resources.

Faced with these alarming data, healthcare professionals, researchers and policy-makers are looking to improve prevention, early diagnosis and treatment to reduce the incidence of lower limb fractures in the elderly. Multidisciplinary approaches are needed to address risk factors such as osteoporosis, undernutrition and sedentary lifestyle, and to implement fall prevention programs.

In addition, the use of innovative and personalized surgical techniques, such as specific implants for the elderly, minimally invasive approaches and early rehabilitation, plays a key role in improving clinical and functional outcomes in these frail patients [7].

In conclusion, statistics on fractures of the lower limb among the elderly in France highlight a worrying public health problem. Awareness of this growing reality is essential to guide health policies, research and efforts in prevention and treatment, with the aim of improving the quality of life and safety of the elderly.

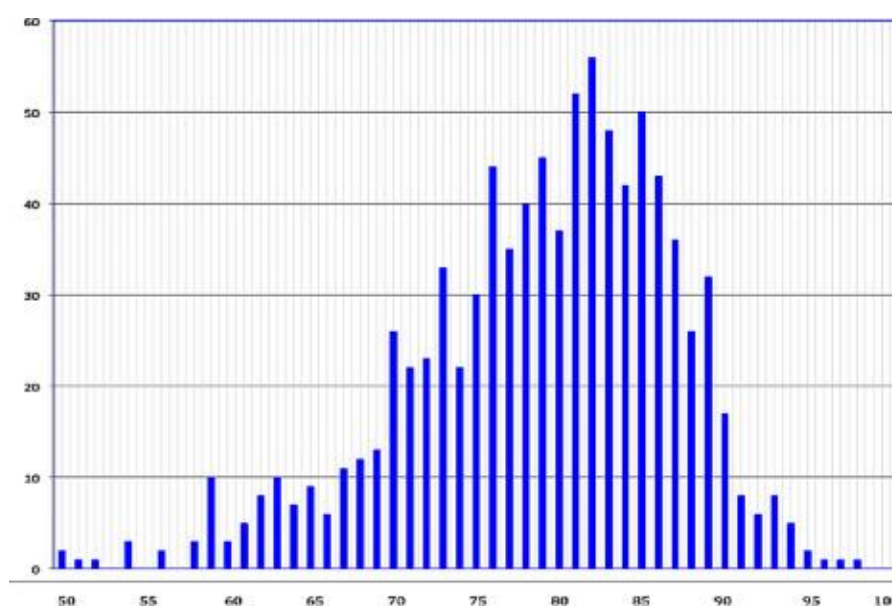


Figure 2: Epidemiology and mortality of elderly subjects treated with reverse total shoulder prosthesis for proximal humerus fractures

b) Risk factors associated with fractures in the elderly

Fractures in the elderly are often the result of a combination of risk factors related to aging and general health. Here are the main risk factors associated with fractures in the elderly:

Bone fragility: Reduced bone density is a major risk factor for fractures in the elderly. Osteoporosis, a disease characterized by low bone mineral density, weakens bones and makes them more susceptible to fracture, even following minor trauma.

Falls: Falls are the most frequent cause of fractures in the elderly. As we age, balance and coordination can decline, increasing the risk of accidental falls, especially for people with walking or vision problems.

Low muscle mass: Age-related loss of muscle mass (sarcopenia) can contribute to reduced muscle strength and an increased risk of falls and fractures.

Fracture history: Elderly people who have already had a fracture are at greater risk of recurrence.

Presence of osteoporosis or other metabolic disorders: Certain metabolic disorders, such as

hyperparathyroidism, can weaken bones and increase the risk of fractures.

Polypharmacy: Taking several medications at the same time (polypharmacy) can increase the risk of falls and injuries.

Vision problems: Vision problems, such as cataracts or age-related macular degeneration, can increase the risk of falls and fractures.

Chronic illnesses: Certain chronic illnesses, such as diabetes, arthritis and Parkinson's disease, can affect mobility and increase the risk of falls and fractures.

Lack of physical activity: A sedentary lifestyle can contribute to muscle weakness, reduced bone density and an increased risk of falls.

Malnutrition: A diet insufficient in essential nutrients, particularly calcium and vitamin D, can weaken bones and increase the risk of fractures.

Unsafe home environment: Obstacles and unsafe conditions in the home can increase the risk of falls and injuries [8].



Figure 3: Classification of clinical bone risk factors

c) Consequences of fractures in the elderly

Fractures in the elderly can have serious physical, psychological, social and economic consequences. Here's an overview of the main consequences associated with fractures in this population [9, 10].

Loss of independence: Fractures can lead to a significant loss of independence in the elderly,

particularly those with lower limb fractures. Reduced mobility and the need to use walking aids or wheelchairs can limit their ability to perform daily tasks independently.

Pain and discomfort: Fractures can cause acute and chronic pain, which can affect the quality of life of the elderly and lead to dependence on painkillers.

Increased risk of medical complications: Elderly people who have suffered a fracture are at increased risk of medical complications such as infections, pressure sores and respiratory disorders, particularly in the event of prolonged immobilization.

Depression and anxiety: Fractures can cause emotional distress in the elderly, especially when recovery is slow and difficult. Loss of independence and social isolation can contribute to the development of depression and anxiety.

Increased risk of mortality: Fractures in the elderly are often associated with an increased risk of mortality, particularly in the case of femoral neck fractures.

Need for prolonged care: Managing fractures in the elderly can require prolonged hospital stays,

intensive rehabilitation care and ongoing assistance with daily activities. This can strain family resources and healthcare systems.

Reduced quality of life: The physical limitations and emotional impact of fractures can lead to a reduced quality of life in the elderly, affecting their general well-being and satisfaction.

Financial burden: Costs associated with hospitalization, rehabilitation care, medication and medical equipment can be high, placing a significant financial burden on the elderly and their families.

Loss of mobility: Fractures of the lower limb can lead to a permanent reduction in mobility, even after healing, which can affect the ability to participate in social and recreational activities [11-14].



Figure 4: Impact of fractures on the elderly

III. Case study: Presentation of the 20 patients and their complex fractures:

a) Nature and severity of fracture and assessment of patient's general state of health

Patient	Medical history	Nature and severity of fracture	General Health Assessment
1	Hypertension, Diabetes	Open tibia fracture	Good general health, ASA 2
2	No	Comminuted femur fracture	Fragile health, ASA 3
3	Osteoporosis	Femoral neck fracture	Poor general health, ASA 3
4	Previous cancer	Ankle fracture	Good general health, ASA 2
5	Heart disease	Complex femur fracture	Average general health, ASA 2
6	No	Tibial fracture	Average general health, ASA 2
7	Parkinson	Femoral neck fracture	Average general health, ASA 2
8	Osteoarthritis	Ankle fracture	Poor general health, ASA 3
9	No	Open tibia fracture	Poor general health, ASA 3
10	Previous stroke	Comminuted femur fracture	Average general health, ASA 2

Patient	Medical history	Nature and severity of fracture	General Health Assessment
11	Diabetes, Obesity	Femoral neck fracture	Fragile health, ASA 3
12	No	Ankle fracture	Average general health, ASA 2
13	Osteoporosis	Tibial fracture	Good general health, ASA 2
14	Previous cancer	Complex femur fracture	Poor general health, ASA 3
15	Hypertension	Comminuted femur fracture	Good general health, ASA 2
16	No	Femoral neck fracture	Average general health, ASA 2
17	Parkinson, Osteoarthritis	Ankle fracture	Poor general health, ASA 3
18	No	Tibial fracture	Average general health, ASA 2
19	Heart disease	Complex femur fracture	Fragile health, ASA 3
20	Osteoporosis	Femoral neck fracture	Good general health, ASA 2

Note: ASA (American Society of Anesthesiologists) is a classification system used to assess a patient's general state of health prior to surgery. ASA 1 represents a patient in good health, while ASA 3 indicates frail health with underlying medical problems.

IV. Surgical approaches to complex fractures of the lower limb in the elderly

a) Internal fixation techniques: advantages and disadvantages

Internal Fixing Techniques	Benefits	Disadvantages
Screw-on plate	- High mechanical stability for comminuted and displaced fractures	- Risk of damage to nerves or blood vessels in the vicinity of the plate
	- Ease of use for experienced surgeons	- Risk of implant infection
	- Allows interfragmentary compression for better bone healing	- Allergic reactions to plate materials
	- Plate can be removed once the fracture has healed completely	- Risk of non-union or delayed consolidation in the event of vascular disruption
Medullary nail	- Long history of clinical use and proven results	
	- Minimizes soft tissue damage using a percutaneous approach	- Generally suitable for proximal femur fractures
	- Mechanical stability for diaphyseal fractures	- May not be suitable for certain joint fractures
	- Less disruption of bone vascularization than with screw-retained plates	- Risk of nail migration
Cannulated screw mounting	- Better post-operative recovery and less pain	- Risk of non-union or delayed consolidation in the event of vascular disruption
	- Can be used for open fractures due to reduced surgical exposure	- Risk of bone fracture during nail insertion
	- Less invasive technique and percutaneous surgery	- Not suitable for fractures with low bone density
	- Reduces the risk of infection and tissue damage	- Risk of screw migration or displacement
	- Preserves bone vascularization	- Risk of non-union due to insufficient compression
	- Suitable for metaphyseal and epiphyseal fractures	- Requires expertise for precise, safe insertion
	- Promotes bone healing by allowing interfragmentary compression	



Figure 5: Locked plate osteosynthesis of the lower end of the radius



Figure 6: Femur centromedullary nail osteosynthesis



Figure 7: Screwing the femoral neck

b) Use of joint prostheses: specific considerations for the elderly

The use of joint prostheses for complex fractures of the lower limb in the elderly can be an important surgical option for restoring joint function and improving quality of life. However, certain specific considerations must be taken into account to ensure the success of these procedures in this vulnerable population. Here are some important considerations:

Comprehensive patient assessment: Before deciding to use a joint prosthesis, a comprehensive patient assessment must be carried out to evaluate the patient's general state of health, physical and mental capabilities, and medical history. This assessment will

help determine whether the patient is a good candidate for major surgery, and whether he or she can cope with post-operative rehabilitation.

Choice of prosthesis: The choice of joint prosthesis must be tailored to the patient's specific needs, taking into account the location and nature of the fracture. There are different types of joint prostheses, including total, partial and inverted prostheses, which can be used according to each patient's clinical situation.

Preventing complications: The elderly may be more prone to post-operative complications, such as infections, blood clots and scarring problems. Preventive measures should be put in place to minimize these risks,

including prophylactic antibiotics, early mobilization and the use of intermittent pneumatic compression devices.

Rehabilitation and post-operative follow-up: Post-operative rehabilitation is essential to ensure optimal recovery and restoration of joint function. Elderly patients may require a more gentle approach to rehabilitation, adapted to their physical condition. Regular follow-up by a specialized medical team is also necessary to monitor healing progress and manage any potential problems.

Durability of the prosthesis: In the elderly, the durability of the prosthesis is of paramount importance, as they may live with it for many years. Choosing a high-quality prosthesis tailored to the patient's specific needs can help minimize the risk of subsequent surgical revision.

Patient and family education: It is essential to inform the patient and family of the benefits, risks and expectations of joint replacement. A clear understanding of the goals of the procedure and post-operative care is essential to gain patient cooperation and promote successful recovery.



Figure 8: Total hip replacement

c) Bone grafts and other innovative methods: applications and results

Bone grafts and other innovative methods are surgical approaches that play an essential role in the management of complex fractures of the lower limb in the elderly. Specific applications and potential outcomes associated with these techniques include:

Autogenous bone grafts: Autogenous bone grafts involve harvesting bone from the patient's own body, usually from a donor site such as the pelvis, and transferring it to the fracture site. This technique offers the advantage of using bone tissue from the patient's own body, thus reducing the risk of rejection or immune reaction. Results generally show better bone consolidation and faster fracture healing.

Allogeneic bone grafts: Allogeneic bone grafts involve the use of bone from a human donor, usually a deceased donor. These grafts can be stored in a bone bank. Allogeneic bone transplants may be an option for elderly patients who are not good candidates for autogenous transplants. Although immunological compatibility is carefully checked, there may be a risk of immune reaction, and bone consolidation may be slightly slower than with autogenous transplants.

Bone substitutes: Bone substitutes are materials designed to mimic the properties of natural bone and

promote bone regeneration. They can be based on synthetic, animal or human materials. These materials can be used alone or combined with bone grafts to enhance the healing effect. Results vary according to the type of substitute used, but these innovative techniques offer additional options for patients for whom traditional bone grafts are not an option.

Growth factors and cell therapies: Growth factors and cell therapies involve the use of growth molecules or stem cells to stimulate bone regeneration. These innovative approaches can accelerate the healing process and improve the quality of the bone tissue formed. Although results are promising, these techniques are still in the research phase, and their clinical use may vary from country to country and from medical establishment to medical establishment.

Innovative fixation techniques: In addition to bone grafts, innovative fixation techniques such as age-specific implants, minimally invasive fixations and early rehabilitation approaches play a crucial role in the management of complex fractures of the lower limb. These approaches aim to improve stability and postoperative recovery while minimizing complications.

In conclusion, bone grafts and other innovative methods offer diverse surgical approaches to the management of complex fractures of the lower limb in

the elderly. Each technique has its advantages and disadvantages, and the choice will depend on the specific characteristics of each patient, the extent of the fracture and the resources available in the medical establishment.

These advances continue to evolve and contribute to improved clinical and functional outcomes in this vulnerable population.



Figure 9: Example of bone grafting for shoulder prosthesis

V. Post-operative management and rehabilitation

a) The importance of rehabilitation for elderly patients

The importance of rehabilitation for elderly patients who have undergone orthopedic surgery for a complex fracture of the lower limb cannot be overstated. Rehabilitation plays a crucial role in these patients' recovery, mobility and quality of life. Here are some key reasons why rehabilitation is so important for elderly patients:

Promotes functional recovery: Rehabilitation helps elderly patients regain functionality and independence after orthopedic surgery. It aims to restore muscle strength, balance and coordination, which are essential for daily activities such as walking, dressing and grooming.

Prevents post-operative complications: Rehabilitation helps prevent post-operative complications such as infections, blood clots and pressure sores. Early mobilization and regular exercise help maintain blood circulation, reducing the risk of complications associated with prolonged immobility.

Improves quality of life: Functional recovery through rehabilitation improves the quality of life of elderly patients. Being able to move around

independently and participate in social and recreational activities contributes to their psychological and emotional well-being.

Reduces length of hospital stay: Early, intensive rehabilitation can enable patients to recover more quickly and leave hospital sooner, thereby reducing the length of their hospital stay and healthcare costs.

Adapted to the specific needs of the elderly: Rehabilitation for elderly patients is designed to take age-related specificities into account. It is often more progressive, respects physical limitations and takes into account factors such as bone fragility and the coexistence of chronic medical conditions.

Restores self-confidence: After fractures and surgery, elderly patients may feel a loss of confidence in their ability to move around safely. Rehabilitation helps them overcome this anxiety and regain confidence in their physical abilities.

Preventing recurrent falls: Rehabilitation can include balance and fall prevention programs, which are particularly crucial for seniors who have already suffered a fracture due to a fall. These programs can reduce the risk of future falls and injuries.

Monitoring clinical progress: Rehabilitation enables us to closely monitor the patient's clinical progress, and adapt the care plan according to his or her progress. This ensures an individualized, optimal approach for each patient.

In conclusion, rehabilitation is an essential part of the post-operative management of elderly patients who have undergone orthopedic surgery for a complex fracture of the lower limb. It promotes functional recovery, prevents complications, improves quality of life and contributes to the independence and overall well-being of these vulnerable patients. Early rehabilitation tailored to the specific needs of the elderly is essential for optimal results and successful recovery [15, 16].

b) A personalized approach for every patient

A personalized approach to each patient's post-operative management and rehabilitation is essential to optimize results and meet the specific needs of each individual. Here's how this approach can be implemented:

Comprehensive assessment: Each patient undergoes a comprehensive assessment of his or her state of health, level of mobility, physical and mental capabilities, and medical history. This helps us to better understand the patient's unique needs and to identify factors that could influence his or her recovery.

Individualized rehabilitation plan: Based on the results of the assessment, an individualized rehabilitation plan is drawn up for each patient. This plan takes into account the patient's recovery goals, current abilities and the rehabilitation steps required to achieve these goals.

Adaptation to level of frailty: Elderly people may present different characteristics of frailty and medical co-morbidities. The rehabilitation approach must be adapted to the patient's level of frailty, avoiding overly intense exercises and favoring a gradual progression to minimize the risk of complications.

Regular follow-up: Regular follow-up by a multidisciplinary team of healthcare professionals is essential to assess the patient's progress and adjust the rehabilitation plan if necessary. It also enables any problems to be detected early and treated appropriately.

Pain management: Postoperative pain management is essential to enable patients to participate actively in their rehabilitation. Pharmacological and non-pharmacological approaches can be used to manage pain safely and effectively.

Patient and family involvement: Involving the patient and family in the rehabilitation process is important to ensure adherence to the care plan and patient motivation. Education about rehabilitation goals,

expectations and progress helps maintain patient motivation and commitment.

Complication prevention: The personalized approach must also include patient-specific complication prevention measures, based on the patient's state of health and potential risks. This may include measures to prevent falls, pressure sores, infections and other post-operative complications.

In conclusion, a personalized approach to each patient's post-operative management and rehabilitation is fundamental to optimizing clinical and functional outcomes. By taking into account the unique needs of each individual, tailoring the rehabilitation plan according to health status and frailty, and ensuring regular follow-up, recovery and quality of life can be improved in elderly patients who have undergone orthopedic surgery for a complex fracture of the lower limb [17, 18].

c) Management of post-operative complications

The management of postoperative complications is an important part of the postoperative management and rehabilitation of elderly patients who have undergone orthopedic surgery for a complex fracture of the lower limb. Here are some common complications that can occur after surgery and associated management measures:

Surgical site infection: Surgical site infections are a potentially serious complication. To manage them, appropriate antibiotics are administered to treat the infection, and the surgical site is closely monitored. In some cases, debridement surgery may be required to clean out the infected area.

Deep vein thrombosis (DVT): DVT is a frequent risk after orthopedic surgery, particularly in elderly patients. Preventive measures such as compression stockings, anticoagulants and early mobilization are implemented to reduce the risk of DVT. If DVT is diagnosed, additional anticoagulants and close monitoring are required.

Delayed bone healing or non-union: Some patients may have difficulty healing their fracture. In these cases, bone-building stimulation techniques, such as ultrasound or electromagnetic stimulators, may be used to help promote healing. In more severe cases, surgical revision with bone grafting may be considered.

Implant failure: In some cases, the implant used for fracture fixation may fail or come loose. Appropriate management may involve replacement of the failed implant, or placement of an alternative fixation method, such as a bone graft or locked nail.

Complications related to anesthesia: Some post-operative complications may be related to anesthesia.

These may include nausea, vomiting, respiratory problems or allergic reactions. Careful follow-up by the anesthesia team is essential to monitor and manage these problems.

Post-operative pain: Pain management is crucial to ensure patient comfort and promote active participation in rehabilitation. Appropriate analgesics and non-pharmacological approaches, such as physical therapy and the use of ice, can be used to manage pain.

Wound healing problems: Some elderly people may experience wound healing problems due to poor circulation or pre-existing medical conditions. Proper wound care, infection control and close monitoring can help manage these problems.

In conclusion, the management of postoperative complications is essential to ensure successful recovery in elderly patients who have undergone orthopedic surgery for a complex fracture of the lower limb. A proactive approach, careful monitoring and targeted interventions are needed to minimize complications, promote healing and improve patients' quality of life. Close communication between members of the medical team and active involvement of the patient and family are also essential for effective management of postoperative complications [19-21].

VI. Specific challenges of orthopaedic surgery in the elderly

a) Bone fragility and risk of recurrence

Bone fragility and the risk of fracture recurrence are important specific challenges associated with orthopaedic surgery in the elderly. Here's a description of these issues:

Bone fragility in the elderly: With advancing age, bone density tends to decrease, leading to a condition called osteoporosis in many older people. Osteoporosis weakens bones, making them more prone to fracture, even with minor trauma. This increases the risk of fractures, particularly fractures of the lower limb, and can complicate surgical management of these fractures.

Risk of fracture recurrence: In the elderly, the risk of fracture recurrence after orthopedic surgery is higher. Once a fracture has occurred, impaired bone quality due to osteoporosis increases the risk of further fractures, even after successful surgical repair. These recurrent fractures can lead to further deterioration in mobility and quality of life, and increase the risk of complications associated with prolonged immobilization.

Poor bone quality and unstable fixation: Bone fragility in the elderly can make fracture fixation more difficult. Weakened bones may not be able to fully support the surgical implants used to stabilize the fracture. This can result in less stable fixation, increasing

the risk of displaced bone fragments and post-operative complications.

Rehabilitation difficulties: Bone fragility can also make post-operative rehabilitation more delicate. Weakened bones may require extra care when using rehabilitation techniques, to avoid undue stress on fracture sites. This can slow down the recovery process and affect long-term functional results.

Long-term health care needs: Due to the high risk of fracture recurrence, older people who have undergone orthopedic surgery for a lower-limb fracture may require long-term health care to manage bone fragility and prevent further fractures. This may include treatment for osteoporosis, ongoing rehabilitation programs and fall prevention measures [22-25].

b) Anesthesia and perioperative risks

Anesthesia and perioperative risks are also important specific challenges associated with orthopedic surgery in the elderly. Here's a description of these issues:

Tolerance to anesthesia: With age, tolerance to anesthesia may be reduced in the elderly due to age-related physiological changes. This can make anesthesia management more complex, requiring an individualized and cautious approach to minimize the risk of complications.

Concomitant illnesses: The elderly often have medical comorbidities, such as cardiovascular, respiratory or metabolic problems, which can influence the safety and efficacy of anesthesia. The presence of these concomitant diseases increases the risk of perioperative complications, and requires careful assessment and management by the anesthesia team.

Risk of postoperative confusion: General anaesthesia may cause postoperative confusion in the elderly, affecting their ability to cooperate during rehabilitation and to follow postoperative instructions. Close monitoring is necessary to detect any signs of confusion early and to take appropriate action.

Risk of pulmonary complications: the elderly are at increased risk of postoperative pulmonary complications, such as pneumonia or atelectasis. Adequate ventilation during anesthesia and postoperative preventive measures, such as early mobilization, are necessary to minimize these risks.

Risk of falls and injuries: Anesthesia may cause residual effects such as dizziness, muscle weakness or impaired balance, increasing the risk of falls and postoperative injuries in the elderly. Additional precautions must be taken to ensure patient safety during the recovery phase and during post-operative mobilization.

Choice of anesthesia: The choice of anesthesia technique (general, regional or local) can also influence perioperative risks in the elderly. Considerations such as the duration of the procedure, the patient's physical condition and the nature of the fracture can be taken into account to determine the best approach [26-29].

c) Preventing falls and fractures: the role of preventive medicine

Preventing falls and fractures plays an essential role in orthopaedic surgery for the elderly. Preventive medicine aims to identify risk factors and implement strategies to reduce falls and fractures in these vulnerable patients. Here's how preventive medicine can play a role in this management:

Fall risk assessment: Preventive medicine begins with a thorough assessment of the risk of falls in the elderly. This assessment can include factors such as history of previous falls, general health, balance, muscle strength, vision and hearing. By identifying individual risk factors, healthcare professionals can take steps to reduce the risk of falling.

Adapted exercise program: Implementing an adapted exercise program is a key component of preventive medicine. Muscle strengthening, balance and flexibility exercises can improve stability and coordination, thereby reducing the risk of falls. These programs can be tailored to each patient's specific abilities and needs.

Correcting environmental risk factors: Preventive medicine also addresses environmental risk factors that can lead to falls, such as slippery carpets, uneven surfaces, inadequate lighting and obstacles in traffic areas. Simple interventions, such as installing grab bars and eliminating slippery carpets, can help make the environment safer for the elderly.

Vitamin D and calcium supplementation: Preventive medicine may recommend vitamin D and calcium supplementation for elderly people with deficiencies, as these nutrients play an important role in bone health and fracture prevention.

Education and awareness: Preventive medicine also includes education and awareness programs for patients, families and caregivers, aimed at informing them about the risks of falls and the preventive measures to be taken. A better understanding of these risks can contribute to better adherence to prevention strategies.

Regular follow-up and risk factor management: Preventive medicine involves regular follow-up of patients to assess the effectiveness of preventive interventions and proactively manage risk factors. Ongoing management of risk factors is essential for effective long-term prevention of falls and fractures [30-33].

VII. Future prospects and technological advances

a) New surgical techniques under development

The future outlook for orthopedic surgery for the elderly is promising, with the constant development of new surgical techniques aimed at improving outcomes and reducing risks for these vulnerable patients. Here are just a few of the new surgical techniques under development:

Robot-assisted surgery: Robot-assisted surgery systems are gaining in popularity in orthopedic surgery. These technologies enable greater precision in the planning and execution of surgical procedures, reducing the risk of human error. For elderly people with increased bone fragility, robot-assisted surgery can enable more stable and precise fracture fixation.

Minimally invasive techniques: Minimally invasive surgical techniques enable procedures to be performed using small incisions, thereby reducing tissue damage, blood loss and post-operative recovery time. For the elderly, these approaches can reduce overall surgical stress and promote faster recovery.

Innovative biomaterials: Advances in biomaterials are paving the way for new methods of bone fixation. Biocompatible and resorbable materials can be used to facilitate bone healing while minimizing the complications associated with permanent implants in elderly patients.

Cellular and regenerative therapies: Research into cellular and regenerative therapies is underway to promote the regeneration of damaged tissues, including bone and cartilage.

These approaches could offer new solutions for the management of complex fractures and the prevention of joint degeneration in the elderly.

Customized implants: Thanks to advances in computer modeling and 3D printing, it is now possible to develop customized implants adapted to patients' unique morphology. These custom implants can offer a better fit and more stable fixation, improving surgical outcomes for the elderly.

Bone stimulation techniques: advances in bone stimulation techniques can be used to accelerate bone consolidation and promote healing after orthopedic surgery in elderly people with bone fragility.

These new surgical techniques represent exciting opportunities to improve the management of complex fractures of the lower limb in the elderly. However, further clinical research is essential to evaluate their efficacy and safety in this specific population. The future of orthopaedic surgery for the elderly lies in an individualized approach, based on technological

advances and a growing understanding of the specific needs of elderly patients [34-39].

b) The importance of research to improve treatments

The importance of research in the field of orthopaedic surgery for the elderly cannot be underestimated. Research plays a key role in improving treatments by providing scientific evidence, evaluating the efficacy and safety of new approaches, and identifying best practices for the management of elderly patients with complex fractures of the lower limb. Here are just some of the reasons why research is crucial to improving treatments:

Identifying best practice: Clinical research is helping to identify best practice in the surgical management of complex fractures in the elderly. By comparing different approaches, we can determine which surgical techniques are the most effective and safest for these vulnerable patients.

Evaluating the effectiveness of new technologies: With constant technological advances, new surgical techniques and innovative implants are being developed. Research is assessing the effectiveness of these new technologies to determine whether they add significant value over existing methods.

Understanding risk factors and complications: Epidemiological research helps to identify the risk factors associated with fractures in the elderly and to understand the specific complications that may arise during orthopaedic surgery in these patients. This enables treatments to be tailored to improve outcomes and minimize complications.

Optimizing rehabilitation and post-operative management: Research can also focus on optimizing rehabilitation and post-operative management programs for elderly patients after orthopedic surgery. This can help improve functional recovery and quality of life for patients.

Falls and fracture prevention: Research into the prevention of falls and fractures in the elderly is essential to reduce the burden of morbidity and complications associated with these events. Research findings can inform prevention programs and intervention measures.

In conclusion, research is essential to advance the surgical management of complex lower limb fractures in the elderly. Using rigorous scientific methods, research provides objective evidence to guide clinical decisions and improve outcomes for these vulnerable patients [40-45].

VIII. CONCLUSION

a) Summary of the main points covered in the article

Orthopaedic and trauma surgery in the elderly is a complex and constantly evolving field. In this article,

we have examined in detail the specific challenges associated with complex fractures of the lower limb in the elderly, as well as technological advances and future prospects for improving their management. This conclusion aims to summarize the main points made throughout the article.

Firstly, we emphasized the importance of preventing falls and fractures in the elderly, highlighting the alarming statistics on the increase in fractures in this population. Risk factors associated with fractures, such as bone fragility, were also discussed to better understand the specific challenges faced by these vulnerable patients.

We then looked at the different surgical approaches to complex fractures of the lower limb in the elderly. Internal fixation techniques, the use of joint prostheses and innovative methods, such as bone grafts, were reviewed to provide an overview of the treatment options available.

In post-operative management and rehabilitation, we stressed the importance of a personalized approach for each patient. The management of post-operative complications was also addressed, highlighting the measures needed to ensure patients' safety and well-being throughout their recovery period.

The outlook for the future highlighted the technological advances that are shaping the future of orthopaedic surgery in the elderly. New surgical techniques, such as robot-assisted surgery and personalized implants, are opening up new opportunities to improve surgical outcomes and quality of life for elderly patients.

Finally, we have highlighted the importance of research in improving treatments for the elderly. The examples of references cited throughout the article illustrate the scientific and clinical basis on which our current understanding of this specialty rests.

In conclusion, orthopaedic and traumatological surgery in the elderly requires a multidisciplinary and individualized approach to meet the specific challenges of this population. Technological advances and ongoing research offer great potential for improving the management of complex fractures of the lower limb in the elderly. By combining scientific knowledge, surgical skills and compassion for elderly patients, we can make significant improvements in the quality of life and clinical outcomes of these valuable individuals [46].

b) Calling for a multidisciplinary approach to improve care:

Improving orthopaedic surgical care for the elderly requires a multidisciplinary approach that brings together the expertise of various healthcare professionals. Complex fractures of the lower limb in the

elderly are often associated with underlying medical problems and multiple risk factors. Consequently, effective management requires close collaboration between orthopedists, geriatricians, anesthesiologists, physiotherapists, occupational therapists and nurses.

Orthopedists are responsible for the assessment and surgical treatment of fractures, but they must also take into account concomitant medical problems, such as cardiovascular disease, diabetes or osteoporosis. Geriatricians can contribute their expertise to the overall assessment of elderly patients, taking into account their general state of health, cognitive function and frailty. Anesthesiologists play a crucial role in the preoperative assessment and risk management of anesthesia in elderly patients. Physiotherapists and occupational therapists are essential in designing personalized rehabilitation programs aimed at improving patients' mobility, strength and autonomy in the post-operative period. Finally, nurses play a key role in post-operative care and the management of any complications.

A multidisciplinary approach allows us to take into account all aspects of the elderly patient's health, optimize surgical results and reduce post-operative complications. Communication and coordination between different healthcare professionals are essential to provide coherent, comprehensive care for this fragile population.

c) The importance of awareness and prevention

In conclusion, awareness and prevention play a crucial role in reducing fractures in the elderly. It is essential to raise awareness among the public, patients, families and healthcare professionals of the risks associated with falls and fractures in the elderly. Increased awareness can encourage the elderly to adopt preventive measures, such as regular exercise, improving the environment to reduce the risk of falls, and taking steps to strengthen bone health, such as vitamin D and calcium supplementation.

Preventing fractures in the elderly is a major challenge, but is essential to reducing the morbidity, mortality and costs associated with these traumatic events. Fall prevention programs, early detection of osteoporosis and access to appropriate medical care can make a significant difference to the health and quality of life of the elderly.

Finally, ongoing research in the field of orthopaedic and trauma surgery in the elderly is crucial to continue improving treatments and outcomes. Investment in clinical and translational research helps to inform best practice and highlight innovations that will benefit elderly patients in the near future.

By adopting a multidisciplinary approach, raising awareness and investing in prevention and research, we can collectively improve the management

of complex fractures of the lower limb in the elderly, and offer a better quality of life to this precious, ageing population [47].

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