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Fractures and Traumatic Injuries: Current Understanding of Epidemiology, Pathophysiology, Diagnosis, and Management-An Updated Review.

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Abstract

Background: There are a number of conditions that cause pain and disability, as well as loss of productivity and mortality throughout the whole world including fractures and traumatic injuries. Population ageing, road traffic and fall-related injuries and occupational, sports and military exposures continue to increase as does their burden, and innovations in imaging, fixation, osteoporosis treatment and rehabilitation are changing clinical practice.

Objectives: This review is intended to review recent epidemiological evidence (between 2021 and 2026) regarding definitions, classification, epidemiology, pathophysiology, complications, and management of fractures and other associated traumatic injuries with emphasis on gaps and future directions.

Methods: The literature was conducted on narrative review of peer-reviewed articles published from 2021-2026. Global burden analyses, systematic reviews and meta-analyses, randomized controlled trials, clinical practice guidelines and consensus statements were considered.

Results: It is estimated that there were 178 million new fractures, and 455 million prevalent fractures in the world in 2019 – and although numbers have increased significantly since 1990 rates are decreasing slightly. The age-specific incidence is highest in older people and mortality following hip fracture is still high. The healing of fractures occurs in a number of stages - inflammatory, soft callus, hard callus, and remodelling - and these stages are disrupted or impaired by infection, instability, ageing and endocrine disease. Evidence from meta-analyses indicates that AI is as accurate as clinicians, but there is a risk of numerous studies being affected by bias. Recent trials justify the use of less complex management of paediatric torus fractures, and aspirin did not prove inferior to LMWH for preventing mortality from an operatively managed fracture in the extremity. Consenseus definitions for fracture related infection have been developed. Fracture liaison services, pharmacotherapy for osteoporosis, falls prevention and exercise rehabilitation are linked to a reduction in subsequent fractures or to improved function; vitamin D alone was not found to reduce fractures in generally healthy adults.

Summary: Fractures and injuries continue to be a significant and increasing public health issue. Therapy is mostly successful if there is a good diagnosis, early and tailored therapy, treatment or prevention of complications, followed by follow-up (secondary prevention of fragility fractures), and structured rehabilitation. There is a need for standardized outcome measures, high quality pragmatic trials and broader roll-out of effective care pathways.

Conclusions: Traumatic fractures have a profound impact on patient wellbeing, with one in three adults sustaining them in their lifetime. There exists a new fracture-related high demand for both research and clinical care, including the role of the FLS, fracture healing, nonunion, fracture-related infection, osteoporosis, and rehabilitation.

Keywords: Fractures; Traumatic Injuries; Fracture Healing; Fracture-Related Infection; Osteoporosis; Fracture Management; Rehabilitation; Epidemiology; Fracture Prevention; Global Burden of Disease.

Introduction

Injuries and fractures are one of the most frequently referred to conditions for which social assistance or hospitalization will be required in countries around the world and are also a common cause for long-term disability. The Global Burden of Disease (GBD) 2019 Study estimated that there were 178 million new fractures, 455 million prevalent cases with acute or chronic symptoms and 25.8 million Years lived with Disabilities (YLDs) in 2019 for fractures. Absolute numbers also increased drastically from 1990 to 2019 although the age standardized ones went down, which is related to the process of ageing and population growth [1]. Injuries are also a key driver of morbidity and mortality in older age; and in the Eastern Mediterranean region, in 2019, the rates of mortality due to injury among adults aged 50 years or over were higher than the global rates [2].

Bones can injure in many different ways. In older people with weak bones we see low-energy fragility fractures of the hip, spine and wrist most commonly, and in younger adults it is high-energy fracture due to

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road traffic crashes, falls from height, sporting injuries, work accidents, and military-related injuries – with soft-tissue, vascular, neurological and visceral injuries common. Buckle (torus) fracture of the wrist commonly occurs in children and is more easily handled by simplified pathways [3,4]. In addition to the initial injury, fractures can; cause pain, loss of independence, venous thromboembolism, and infection, as well as nonunion, chronic disability and death, and repeated demand for imaging, surgery, rehabilitation and follow-up.

There has been a significant increase in the evidence that is relevant to everyday practice in the last five years. The long-held national guidelines and immobilization protocol with regard to the prophylaxis of fracture-related infection have been questioned due to big pragmatic trials, and the definition of fracture infection has been standardized internationally, whereas the role of artificial intelligence (AI) tools for fracture detection through meta-analyses is now questioned, and new guidelines have refined the management of secondary fracture prevention and falls. This review aims to summarise the committee's recent review of strongly available evidence (2021-26) relating to definitions and classification, epidemiology, pathophysiology, complications, diagnosis, management, and to highlight some limitations to current research and potential avenues for further research and advancement in the prevention, individualized treatment, rehabilitation and long-term outcomes of fractures and associated traumatic injuries.[5,6]

Definitions and Classification

Trauma is physical injury resulting from the application of mechanical (or thermal, chemical or radiant) energy to the body that exceeds tissue tolerance. A fracture is a break in the continuity of bone. May be partial or total, with injuries to skin, nerves, vessels and muscle surrounding the area. The classification of fractures varies considerably in clinical use and research because the fractures are very different in cause, anatomy and prognosis.

Fractures are classified aetiologically as traumatic (typically a high-energy fracture), fragility (low-energy fracture), stress [fatigue or insufficiency fracture] or pathological (fracture for bone weakened by a tumour or other cause of disease). The clinical manifestation of osteoporosis is fragility fracture, which occur without an event normally required to fracture normal bone, such as a fall from the standing height or less, and is diagnosed densitometrically at a T score of –2.5 or below at the femoral neck, total hip, lumbar spine or 1/3 radius site [7]. Fractures are either closed or open fractures; closed fractures are fractures that have no penetrating soft-tissue breakage, open fractures are fractures that do break through the surrounding skin and are classified with the Gustilo–Anderson system for selection of antibiotic treatment and complexity/schedule of soft-tissue coverage. Fractures are classified by the type of fracture by the morphology; transverse, oblique, spiral, comminuted, segmental, impacted, avulsion and by how much the fracture is displaced, angled or shortened. Anatomical involvement is differentiated as diaphyseal, metaphyseal or epiphyseal (articular) involvement, and metaphyseal injuries in children are classified by Salter–Harris system. AO/OTA classification incorporates an alphanumeric system that helps to specify both the position and type of fracture in terms of a bone, segment and fracture pattern, and is used in registries and trials.[8]

You can also find large-scale epidemiological work that has been based on anatomical groupings; for instance, the burden of fracture was estimated in GBD 2019 across 12 anatomical locations and by the individual causing the fracture (e.g. falls [1]). In multiply injured patients, the severity of the injury is often summarized as the Injury Severity Score and care is planned around a primary and secondary survey. Important things about accurate classification is because it allows for a good choice of treatment, a prognosis, comparability of studies, and for registries to follow up patient outcomes over time.

Epidemiology

Fractures are an important burden of disease in the world. The incidence of fractures (new cases) in the 2019 analysis of the GBD 2019 (204 countries and territories) showed a global rate of 178 million new cases, an increase of 33.4% from 1990; 455 million prevalent cases (an increase of 70.1% from 1990) and 25.8 million YLDs (an increase of 65.3% from 1990). In contrast, age-standardized rates fell slightly: incidence was 2296.2 per 100,000 population (a decrease of 9.6%), prevalence 5614.3 per 100,000 (a decrease of 6.7%), and YLDs 319.0 per 100,000 (a decrease of 8.4%). The fractures in the lower leg (patella, tibia or fibula, or ankle) were the most common and the most burdensome with an age-standardized incidence of 419.9 per 100,000 population. The incidence of the disease was highest for the oldest age groups—15,381.5 cases per 100,000, in those aged 95 years and above [9]. The results indicate that fracture-related disability is growing in prevalence despite the fact that the risk of fracture has levelled off or decreased among individuals.

Fractures are just a part of the injury burden. An analysis of adolescents (aged 10-24 years) for the GBD 2019 indicated 58% of adolescent injury deaths were caused by transport injuries and 31.1 million DALYs in 2019. It also identified a relative change from high income to low income, and from low to low-middle income, (HII countries to LMI countries) in the injury burden [6]. The injury mortality rates were higher among adults (50 years and older) in the Eastern Mediterranean region than in the world and were higher among males than among females [10].

This is more relevant to the region of fragility fractures and more specifically Saudi Arabia and the Gulf. A prospective two-year survey of the 15 hospitals (2017/2018) estimated the incidence of hip fractures in Saudi citizens >50 years old at 2,949 cases per year in 2015, and projected an increase in number to 20,328 by 2050, with a 690% increase in the number of hip fractures. Hip fracture incidence rates were similar to those reported from Abu Dhabi and Kuwait and the survey was utilized to create a Saudi-specific fracture risk assessment (FRAX) model [11,12].

The effects of hip fracture are very serious. The 30-day mortality rate for hip fracture has been reported as 5%–10%, and is likely to be about 30% at one year [8]. In addition, a metaanalysis of preoperative predictors was carried out and patient characteristics that were predictive of early postoperative death were identified that could be used to identify high-risk patients [13]. The mortality is especially high in patients with major comorbidities: the mortality rate after hip or spine fracture was ~50% five years after end-stage kidney disease [14].Bone injuries are unique to the occupational and military groups. If not the biggest reason, stress fractures make their way into the training time of military recruits. Earlier reports of an 8-wk period prevalence of 0.9%–5.2% in men and 3.4%–21.0% in women during basic combat training (BCAT) were summarized in a systematic review [15] of non-modifiable risk factors that reported a US Army cohort with 19.3 male and 79.9 female recruits per 1,000 developing stress fractures during a 10-wk training period.

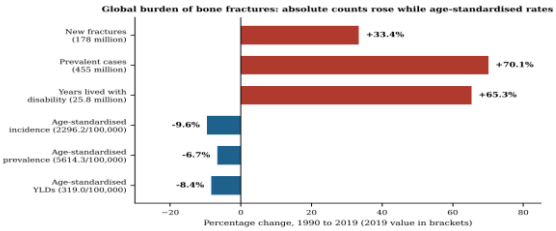


Figure-1: Epidemiology and global burden of fractures, 1990–2019 (data from the GBD 2019 Fracture Collaborators [1]).

Pathophysiology

Mechanisms of Injury and Bone Failure

When the load placed on a bone is greater than the strength of a bone, a fracture will result. Both bone strength, which depends on bone mass, microarchitecture and material properties, and the load depends on the direction, magnitude and rate of load application. The different bending, torsion, axial compression, shear and traction (avulsion) forces create different fracture patterns. In high energy mechanisms, the damage is more likely to occur through comminution, with soft tissue damage likely to be caused, while in osteoporosis the threshold for failure is decreased and a fall from standing height may be enough to cause damage [16]. A systemic response to severe fracture also occurs: blood loss (significant in pelvic and femoral fracture), release of inflammatory mediators and, in case of major trauma, dysregulated immune and coagulation response which increases the risk of organ dysfunction and thrombosis.

Fracture Healing Biology

Healing of fractures is a regenerative process, which to a large extent restores skeletal development. There are two modes that are known [17]. Primary (direct) healing involves anatomical reduction and high stability with little interfragmentary strain, and involves the formation of the “cutting cones” by osteoclasts which cross the fracture line to form new Haversian channels and the union of bone with little or no callus visible. Secondary (indirect) healing is when there is micromotion present such as after intramedullary nailing or external fixation and is established by callus formation by intramembranous (hard callus) and endochondral (soft callus) ossification. The healing process occurs in four stages which overlap: haematoma formation and inflammation, cartilage soft callus formation and angiogenesis, cartilage removal and calcification (hard callus) and the long-term remodelling phase, in which woven bone is replaced by lamellar bone [18].

Impaired Healing and Nonunion

Failure to heal (nonunion) or delayed healing can occur if the mechanical instability, infection, lack of blood supply or host factors interfere with these phases of healing. The remodelling stage is prolonged by ageing and endocrine diseases, and a chronic low-grade inflammation (inflammaging) can affect the healing process and result in a microenvironment that is senescent and has decreased regenerative capacity [19]. In human clinical practice, nonunions are generally classified as hypertrophic (with abundant callus formation, usually associated with excessive motion) or atrophic (little callus formation, usually reflecting poor biology and/or vascularity) and this classification will inform surgical approach. A number of host and local factors are known and recognition and correction of these factors is part of treatment: smoking, uncontrolled diabetes, malnutrition and deep infection.**Mechanical Overload and Stress Fractures**Stress fractures are a form of cumulative fatigue damage (i.e. a repetitive sub-maximal load exceeds the bone's ability to repair itself). They are especially vital for military recruits, athletes and other physically active individuals. A systematic review identified risk factors as either modifiable or non-modifiable, and recommended optimisation of conditioning for trainees at higher risk and increasing the duration of training or decreasing training intensity to accommodate

adaptation to reduce risk [20].

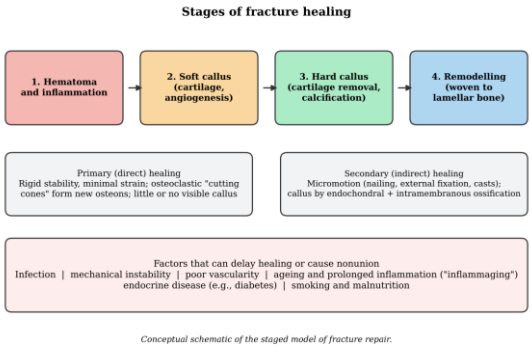


Figure-2: Stages of fracture healing and factors that impair it.

Clinical Presentation and Diagnosis

Clinical Assessment

Symptoms of a fractured bone include pain, swelling, deformity, bruising, and tenderness over the bone, and loss of function of the affected area—some times with crepitus or abnormal movement. For patients with multiple injuries a primary survey must be completed first, which will include airway, breathing, circulation, haemorrhage, and then definitive care for the fracture. The injured limb should be evaluated for skin integrity, distal neurovascular status and the soft-tissue envelope. Open wounds in the immediate vicinity of a fracture should be considered open fractures until they can be excluded otherwise. If there is pain that is out of proportion to the injury, pain on passive stretch and tense swelling should heighten the suspicion that the patient may have acute compartment syndrome and they should be immediately evaluated.

Fracture Healing Biology

Plain films in both orthogonals are the initial study in at least two planes above and below the area of concern are the first choice. Complex articular, pelvic, acetabular and spinal injuries are treated using computed tomography and magnetic resonance imaging is useful for occult fractures, stress injuries and associated soft tissue and ligamentous damage is treated. Children: Ultrasound is also being used at the point of care in selected fractures in children and may be reducing radiation exposure in children.

Impaired Healing and Nonunion

Failure to diagnose or delay diagnosis of fractures on emergency imaging has been known to cause harm and AI systems have been suggested as a second reader. In internal validation sets, the pooled sensitivity of AI was 92% compared to 91% for the clinicians, with no statistically significant difference, but the pooled specificity was 91% compared to 92%, with no significant difference (22 of 42 studies [52%] were considered to be at high risk of bias) [21]. A later meta-analysis of 66 studies showed that the highest pooled sensitivity and specificity for hip fractures were 92% and 90%, respectively, and that the use of image data was more accurate (sensitivity 92%, specificity 91% vs. tabular data, 81%, 83% respectively) than was the use of tabular data, and that radiographs performed better (sensitivity 94%, specificity 92%) than identical data from other imaging methods (sensitivity 82%, specificity 83%). It also highlighted patient selection and reference standards as significant issues of possible bias and applicability [22]. All of these results indicate that AI has great potential as an add-on but it is not yet a replacement for clinician judgement, and further clinical trial validation in the future is needed.

Mechanical Overload and Stress Fractures

Children

Distal radius fractures are among the most frequently fractured bones in the upper limb and the most common fractures in children are torus (buckle) fractures of the distal radius, which is usually caused by a fall onto an outstretched hand [3]. A total of 965 children aged 4–15 years with a distal radius torus fracture (DRTF) were randomly allocated to 23 UK emergency departments to receive either a soft bandage and immediate discharge or rigid immobilization and follow-up in the emergency room. At 3 days, there were no differences between groups in terms of pain, and no differences between groups at 6 weeks follow-up in pain or function [23]. Overall, these findings call for de-escalated treatment of uncomplicated torus fractures, but the study did not include children with greenstick fractures or other fractures, and there may be some implementation challenges due to parental preference for rigid immobilization.

Older Adults and Fragility Fractures

Older people have the largest age-specific fracture rates [24] and hip fracture is a significant cause of death and loss of function in older age [8,9]. Surgical management is the mainstay of treatment and early surgery, orthogeriatric co-management and early mobilization are recommended in most cases. Fragility fractures should also be viewed as a sentinel event for osteoporosis – guidelines say a patient who has had a fracture should be referred for osteoporosis evaluation and treatment, rehabilitation and fracture liaison services/multidisciplinary programmes for transition management. Importantly, many of the highest-risk patients that have a fracture do not receive a diagnosis of osteoporosis or effective therapy [5].

Chest Wall Injury

Rib fracture is one of the most frequent injuries following blunt trauma, and is linked to pain, ventilation impairment, pneumonia and extended intensive care unit (ICU) stay. A meta-analysis of eight RCTs (752 patients) showed that surgical fixation of rib fractures resulted in less mechanical ventilation, fewer days spent in the intensive care unit and hospitalized, pneumonia, and tracheostomy, but no significant difference in quality of life six months after surgery [25]. Patient selection and timing are

still under investigation and benefit has been demonstrated in ventilator-dependent flail chest.

Military Personnel and Athletes

The most common bone injuries in recruits and athletes include stress fracture of the tibial tuberosity, metatarsals and femoral neck — which are more common in women [26]. Prevention strategies should include slow progressive training, focus on nutrition and bone health and early assessment of persistent focal bone pain as early diagnosis will be more beneficial in reducing recovery time and minimising progression to fracture.

Complications

Venous Thromboembolism

VTE is a significant complication of fracture, contributing to morbidity and mortality. Patients with extremity fractures and/or any pelvic or acetabular fracture who were treated surgically were randomized to receive either aspirin (81 mg twice daily) or low molecular weight heparin (LMWH) enoxaparin 30 mg twice daily) in the hospital and were enrolled in the pragmatic multicenter randomized non-inferiority PREVENT CLOT trial; 12,211 patients were enrolled. Non-inferiority of aspirin was confirmed with death at 90 days being seen in 47 patients (0.78%) of the aspirin group and 45 (0.73%) of the heparin group. Aspirin was slightly more likely to occur than was the rest group with deep-vein thrombosis (2.51% versus 1.71%), and rates of pulmonary embolism, bleeding, wound troubles and infection were comparable [27]. The average age of the patients is around 45 years, and there are some dangers in generalizing the results to older, weaker persons.

Fracture-Related Infection

Infection following orthopaedic trauma is a potentially devastating complication known as fracture-related infection (FRI). In 2018, the term and its consensus definition was introduced globally, and in the subsequent years, guidelines for prevention, diagnosis and treatment were released [16,17]. The distinction is between confirmatory (fistula, sinus, wound dehiscence associated with bone or implant) and suggestive clinical, radiological, and laboratory parameters [17]. The most frequent causes of infection are contamination at the time of injury or surgery, whereas haematogenous seeding is not that common [28]. In general, the treatment is performed in a multidisciplinary team and includes surgical debridement, deep-tissue sampling for microbiology, fracture stabilization, and culture-directed antimicrobial therapy; and it requires determination of the stability and healing status of the fracture to decide whether to keep or exchange the implant [16,17]. There is still a lack of evidence regarding perioperative antibiotic prophylaxis and the optimum surgical strategy [29].

Nonunion, Malunion, and Other Complications

Nonunion and malunion are still significant causes of chronic pain and disability, and will frequently require revision surgery, correction of mechanical, biological and infective factors [11]. Other complications are acute compartment syndrome, neurovascular injuries, post-traumatic arthritis, complex regional pain syndrome and chronic pain. In older patients, medical complications like pneumonia, delirium, pressure injury and cardiac events play a significant role in the death and are an important focus of orthogeriatric care [30].

Current Management

The principles of fracture management include resuscitation and treatment of life-threatening injuries, analgesia, realignment (reduction) of fractures, stabilisation until the fracture heals, prevention and treatment of complications and early rehabilitation. Non-operative treatment is favored in certain fracture patterns, fractures which are considered stable, good soft-tissue envelope, young patients without co-morbidities, less functional demands, and patient choice. Treatment of open fractures involves immediate antibiotic, soft-tissue coverage, fracture stabilization and debridement. Two trends in current practice have been outlined in recent trials and meta-analyses: de-escalation is just as effective in selected cases, such as paediatric torus fracture [4] and thromboprophylaxis using aspirin [15] and selective escalation is likely to be advantageous in selected cases, such as ventilator-dependent flail chest [31].

The pharmacological treatment and secondary prevention.

Multimodal (regular Paracetamol, regional nerve blocks and short course opioids for severe pain) and opioid-sparing is recommended for analgesia. In patients with fragility fracture, it is important that osteoporosis is treated. Current recommendations include individualised treatment with antiresorptive agents (bisphosphonates and denosumab) and anabolic agents (teriparatide, abaloparatide, romosozumab) as well as calcium and vitamin D supplementation, avoiding smoking and excessive alcohol consumption, weight bearing and resistance exercise, and fall prevention [5]. The effects of anabolic agents are temporary and need to be followed with antiresorptive therapy; the best sequencing of anabolic therapy, antiresorptives and off periods is not yet established and drug holidays every 1-2 years are likely to be necessary to reduce the risk of atypical femoral fracture [18]. The question of whether or not to continue denosumab forever has also been discussed [32].

It does not seem that vitamin D with or without calcium will reduce fractures in healthy (normal) adults. There was no reduction in non-vertebral or hip fractures and in the VITAL ancillary trial (25,871 participants; vitamin D 2000 IU/day, calcium not specified), fractures occurred in 769 of 12,927 trials (vitamin D group) and 782 of 12,944 trials (placebo group) (hazard ratio 0.98; 95% CI 0.89–1.08). The trial did not recruit patients who were vitamin D

deficient, had low bone mass or osteoporosis, so the results cannot be extrapolated to these patients [33].

Fracture Liaison Services

Fracture liaison services (FLS) are integrated fracture care programs that identify individuals who have a fragility fracture, assess fracture risk, initiate fracture treatment and monitor adherence. A systematic review and meta-analysis revealed that there was a significant reduction in the risk of subsequent fracture and mortality associated with FLS care, with the benefit for mortality only being seen in those with pre- and post-FLS studies [44]. A number of other reviews highlighted the need for a rapid assessment of patients within FLS, allowing those who are eligible to access the appropriate type of therapy, as well as the fact that hybrid services (e.g. osteoporosis liaison services and orthogeriatric services) have developed as part of the Capture the Fracture programme which was introduced in 2012 [34]. The practical implementation of FLS pathways in the Saudi Arabia military and national health systems with a country-specific FRAX model [43] is an excellent chance to bridge the treatment gap in Saudi Arabia.

Falls Prevention

Falls prevention plays a key role in the secondary prevention of fragility fractures since the majority of fractures occur as a result of a fall. Falls risk assessment and physical activity advice should be offered to all older adults; opportunistic falls risk assessment should be used in older adults living in the community; and comprehensive falls risk assessment, with multidomain interventions customized according to the falls risk, should be offered to high-risk older adults.Advise all older adults on falls prevention and physical activity; conduct opportunistic falls risk assessment of older adults living in the community; and provide a comprehensive falls risk assessment and multidomain falls risk management intervention tailored to the individual falls risk for high-risk older adults.

Rehabilitation

Structured rehabilitation is a critical treatment for fracture and strongly associated with good recovery in terms of functionality. A meta-analysis of 15 randomized trials showed that intensive exercise immediately after hip fracture surgery appeared to be superior to regular or no exercise on the outcome of physical function (standardized mean difference 0.74, 95% CI 0.25–1.23) and was beneficial on gait speed, timed up and go test, balance, and activities of daily living, albeit with low quality of evidence [35]. In a meta-analysis of 21 trials (2,470 participants), an exercise program at home was found to improve exercise performance (balance, timed up and go, physical QOL, knee extensor strength), but not to result in any increased emergency visits, readmission or falls, nor in significant improvements in gait speed, 6-minute walk test or ADL [42]. Eight trials (1,617 patients) in a systematic review also showed an enhancement in physical function and gait ability with exercise-based programmes but no evidence of preventing further falls [36]. The evidence as a whole advocates early, progressive, individualized exercise following fracture, with home-based exercise programmes post-discharge, but also calls for larger, trials with a standardized outcome.

Emerging Approaches and Future Directions

There are likely to be many factors that will influence the care of the future. First, before using AI to assist in the interpretation of images, prospective, externally validated trials, with standardized reporting, should be conducted [39,40]. Secondly, knowledge of the role of inflammation and ageing, and the interaction between these two factors and the role of the endocrine system in repair may enable more targeted approaches to prevent or treat nonunion [41]. Third, with the use of standard definitions and outcome measures, for fracture-related infection there will be improved comparisons between the prevention and the treatment strategies. Fourth, pragmatic trials of known treatments such as PREVENT CLOT and FORCE are useful for evaluating the utility of streamlining common treatment without compromising safety.Fourth, pragmatic trials of known treatments like PREVENT CLOT and FORCE could provide a model to assess the utility of streamlining common treatments without sacrificing safety. Last but not least, country-specific information, e.g. the Saudi FRAX model and projected rising incidence of hip fractures should be made available to national fracture-prevention programmes and fracture registers [38].

Limitations of This Review

It is a narrative review and is not done systematically. Some of the earlier "landmark" studies were not cited directly, but are captured in the newer syntheses and guidelines cited herein, with the reference list intentionally limited to the more recent (2021-2026). Some of the included meta-analyses were conducted on studies of different quality and seemed to be very heterogeneous, and some of the estimates (such as mortality following hip fracture, accuracy of AI) differed according to the population and study design.

Conclusion:

Injuries and fractures are a significant and increasing burden, caused by aging population, fall, road traffic accidents and activity participation in work and military environment. Recent evidence indicates that accurate and timely diagnosis, individual selection of non-operative and operative interventions, and preventing and early recognising complications like venous thromboembolism, fracture-related infection and nonunion, as well as systematic secondary prevention of fragility fracture through the fracture liaison service (FLS), osteoporosis treatment and falls prevention. It is better to have structured, early

exercise-based rehab for functional recovery. High quality pragmatic trials, consistent definitions and outcomes, validated AI tools and use of national fracture-prevention pathways adapted to local epidemiology will help to facilitate future progress.

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