

External fixation in the elderly

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KEY WORDS

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ABSTRACT

Orthopaedic trauma is an increasingly common problem in geriatric patients. As demands of daily life and recreational activities are increasing in these patients, surgeons need to be able to manage geriatric fractures to achieve good functional results. Reduced bone quality in the elderly presents a considerable challenge and may preclude the use of established surgical stabilisation techniques that are performed in younger trauma patients. Furthermore, pre-existing medical conditions and considerable comorbidities in the elderly could complicate standard surgical procedures that younger patients would be offered. In this respect, application of external fixators represents a validated, minimally-invasive treatment opportunity. This review article summarises the use of external fixation in geriatric trauma patients for wrist fractures, proximal femoral fractures, pelvic fractures, and ankle fractures. Modern modifications, like pin coating with hydroxyapatite, and aspects of pin care will be discussed.

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Introduction

Orthopaedic trauma is an increasingly common problem in geriatric patients due to the demographic changes in modern civilisations. Fractures are a common injury sustained by the elderly [1]. As life expectancy continues to rise, demands on the body from daily life and recreational activities are increasing. Fracture treatment in the elderly is challenging due to the reduced bone mineral density commonly found in geriatric patients [2]. Fractures of osteoporotic bone have been evaluated to be more displaced [2-5] and unstable [2,6-8] compared with non-osteoporotic fractures. The central goal of fracture treatment is to restore normal function [2]. Thus, anatomical reconstruction and fracture stabilisation represent the central aim to enable early mobilisation and good functional recovery [2]. Biomechanical analyses revealed screw fixation to have a less strong association with decreasing bone mineral density [9-11]. Primary stability [12], initial loosening [13], and fixation strength are affected in different regions [13,14]. This may result in cutting out of screws or plates in geriatric trauma patients with complex and painful fracture displacements [15].

Besides the surgical challenge of adequate fracture treatment, geriatric trauma patients are compromised due to considerable comorbidities and pre-existing medical conditions [16-21]. Trauma is potentially devastating to the elderly because of poor physiological reserves in this population [1]. Any sustained

fracture can be a life-changing event and result in a previously independent individual falling into a pattern of hospitalisation and generalised decline [1]. External fixation offers various advantages compared with other fixation methods for a geriatric trauma patient [22-24]; it is a minimally-invasive technique, the application of which is a valuable tool in the management of fractures and other complicated musculoskeletal conditions [25]. External fixation has been validated as fast, relatively simple, and an atraumatic technique [24,26] that enables easy reduction of the fracture even in unfavourable soft tissue conditions [24,27]. Furthermore, fixation stiffness can be modified during the course of treatment to enable proper manipulation of the healing process [24]. Finally, external fixation treatment is comparatively cost-efficient [24]. Despite these advantages, complications due to the progressive mechanical deterioration of the bone-pin interface followed by pin loosening (Figure 1) and infection (Figures 2 and 3) are known [23,24,28,29].

The surgical challenge of geriatric fracture treatment stems from bone quality aspects and patient-associated factors like comorbidities and pre-existing medical conditions. Complex reconstruction surgery could be an unfavourable option in many cases. External fixation represents an established minimally-invasive treatment opportunity [24,26,30,31]. The use of external fixation in geriatric trauma patients is summarised according to anatomic region in the following sections. Potential complications and options for prevention are described.

Geriatric wrist fractures

The most common fracture associated with reduced bone density is that of the distal radius [12,32]. Most distal radial

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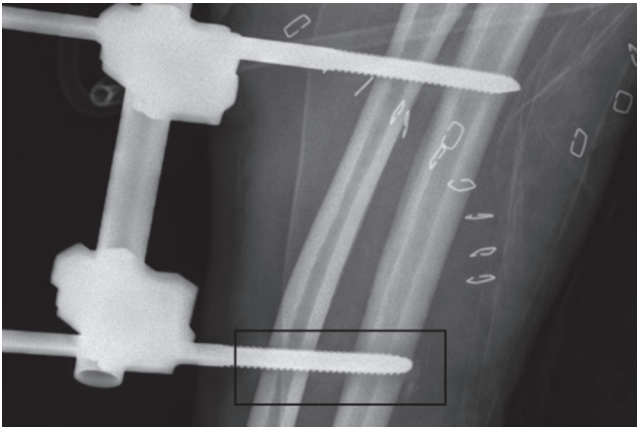


Fig. 1. Pin loosening of an external fixator of a 75-year-old female patient who sustained a complex elbow fracture.

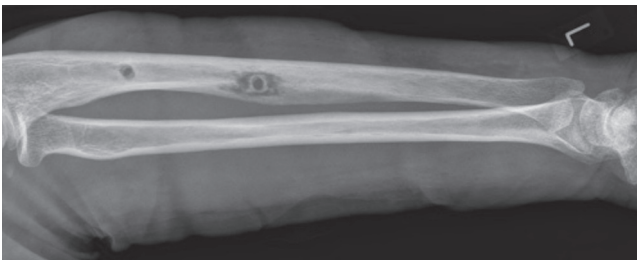


Fig. 2. Risk of infection due to external fixation. The area of the former distal pin shows the radiographic signs of osteomyelitis.

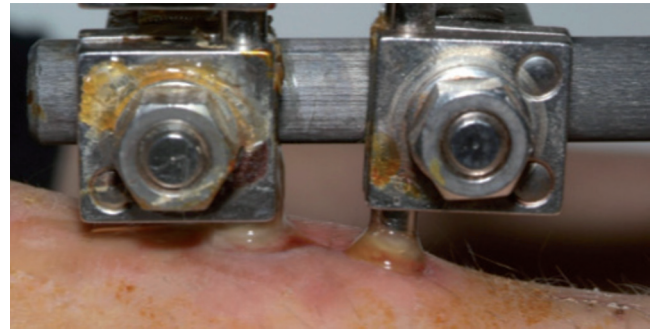


Fig. 3. Superficial pin track infection.

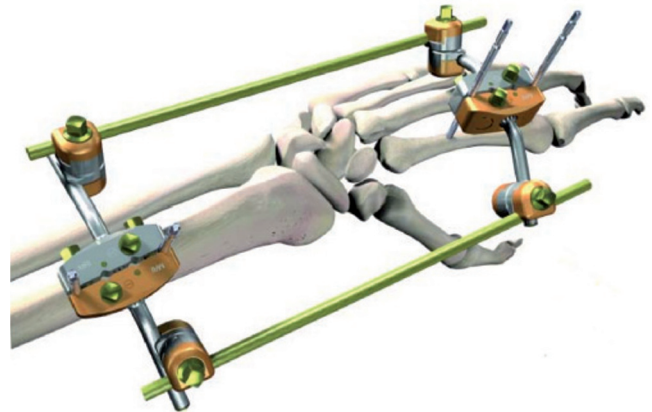


Fig. 4. Stryker® system illustrating a bridging external fixator used for distal radius fractures. (Figure provided by Stryker® Trauma & Extremities, Kiel, Germany).

fractures in the elderly are sustained in a simple fall or from low-energy trauma [33]. In the last century, distal radial fractures in adults were commonly treated conservatively, by reduction of the fracture, if displaced, and stabilisation in a plaster cast or other external brace [34]. The results of such treatment, particularly in older people with bones weakened by osteoporosis, are not consistently satisfactory [35]. The porous fracture ends are unable to withstand axial compression, which results in malunion and poor functional results [33]. Comminuted, osteoporotic low-energy fractures are unstable injuries that require surgical stabilisation [33]; however, controversies exist about whether elderly patients should be offered the same treatment as younger patients, for whom the trend is towards open reduction and internal fixation using volar locking plate systems [33,36]. Within external fixation, 'non-bridging' and 'bridging' fixators are differentiated [34]. In case of 'non-bridging' (of the wrist joint), the distal pins are placed in the distal radial fragment leaving the radiocarpal joint free to move [34]. In case of 'bridging' fixators, the distal pins are placed in one or more metacarpal bones (Figure 4) [34]. Both techniques are compared to closed reduction and cast immobilisation, percutaneous K-wire fixation, and volar locking plate systems in the currently available literature [36]. Diaz-Garcia et al. compared these surgical options in geriatric trauma patients in 21 studies conducted between 1995 and 2009 and reported what is currently the largest systemic review [36] apart from Cochrane analyses, which focused on only adult patients in general [32,35]. According to Diaz-Garcia et al., external fixation is the most used technique for intraarticular fractures in geriatric patients ('non-bridging' 20%, 'bridging' 51%) followed by volar locking plating systems and conservative treatment by cast. The fixation devices were commonly applied for 6 weeks (range 5 to 8 weeks). Functional outcome was evaluated by analysing wrist flexion

and extension and forearm rotation. The best results were seen in patients who were treated with volar plates; they achieved similar motion to patients who were treated with 'non-bridging' external fixators. No differences were found in the grip strength of the impaired hand. Diaz-Garcia et al. reported differences in radiographic findings with volar plate osteosynthesis and 'non-bridging' external fixators, with better volar tilt observed for the 'non-bridging' external fixators compared with the other techniques. This finding was considered to be of only minor interest because wrist function in the elderly is not related to wrist deformity [2,3,36–40]. In summary, there were no clinically-relevant differences of function according to the DASH score (Disability of Arm, Shoulder and Hand) [36]. Furthermore, currently available randomised controlled studies of unstable distal radius fractures in a range of patients (not restricted to the elderly), showed that functional outcome one year after surgery in patients treated with volar locking plate systems was comparable with that in patients treated with 'bridging' external fixators [41,42]. Nevertheless, there are limitations to activities of daily living during the time of immobilisation in patients who underwent 'bridging' fixation [36]. The most common minor complication described by Diaz-Garcia et al. was superficial pin-track infection in patients treated with external fixation (47%) [36]. External fixation led to the highest rates of nerve lesions and pain syndromes (15%). In contrast, ruptures or adhesions of the flexor pollicis longus tendon and the extensor pollicis longus tendon were found to be the most common major complications that required surgery in patients treated with volar locking plate systems (11%) [36]. In summary, external fixation commonly resulted in the highest proportion of minor and major complications that did not require surgery, whereas surgery with volar locking plate systems resulted in the highest proportion of major complications that required surgery [36].

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