Use of a "Kickback" screw in olecranon fractures stabilization increases stability

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Background

Plate fixation continues to be an effective tool to address unstable olecranon fractures, but the presence of osteoporotic bone often leads to complications that result in undesirable fixation failure when subjected to external loads. Previous studies have sought to elucidate the differences between various implants to determine if certain design elements provide superior stability during loading, but no significant differences were found. The use of an additional screw, placed out of plane, in the proximal fracture segment may increase stability. The screw is targeted from distal to proximal through the plate and is aimed towards the tip of the olecranon ("kickback" screw—Figure 1). No biomechanical testing has been performed to determine whether the addition of this screw provides additional stability to the ulna during dynamic loading. The goal of this study was to determine the efficacy of the kickback technique by applying a series of increasing loads to the distal ulna during prescribed elbow flexion/extensions. We hypothesized that utilization of a kickback screw would improve the stability of the construct in comparison to implants that did not receive the screw.

Materials and Methods

Eight paired, fresh-frozen, cadaveric forearm specimens were used for this study (2M, 2F, average age: 88.25). All soft tissues were removed except the elbow capsule, triceps, and radioulnar interosseous ligament. Four Synthes 3.5mm LCP olecranon plates were implanted using the standard surgical technique, while the other four plates were implanted with an extra "kickback" screw. To simulate a comminuted fracture, a transverse osteotomy was created at the center of the sigmoid notch of each specimen and a second osteotomy was made 3 mm distal to the first osteotomy. The bone between the osteotomies was removed so that there was no bony contact between the proximal and distal portions of the ulna. The triceps tendon was sutured to a looped nylon strap to enable a flexion/extension motion of the elbow during displacement-controlled motion of the actuator of the Bose 3550 test frame. To examine the performance of the plates, biomechanical testing followed a previously published protocol. Briefly, the sectioned ends of the humerus and radius/ulna were potted in poly(methyl methacrylate). With the humerus secured to the test frame, the radius/ulna pots were fitted to a custom-built aluminum fixture (mass = 1.2kg) that allowed for the incremental attachment of hanging masses at a distance of 22.5cm from the olecranon fossa. 20mm of displacement of the triceps tendon corresponded to a range of motion between 90° and 60° of flexion. Motion between bone fragments was tracked with a 3-D motion tracking system (Optitrack) to within 0.1mm of accuracy. The arm was initially cycled 30 times at 0.2 Hz with an empty fixture, weighing 1.2kg. This process was repeated by increasing the hanging mass in 0.5kg increments until failure occurred. Failure was defined as 1) permanent relative displacement of the proximal and distal fragments of more than 3 mm, or 2) catastrophic failure of the bone or implant.

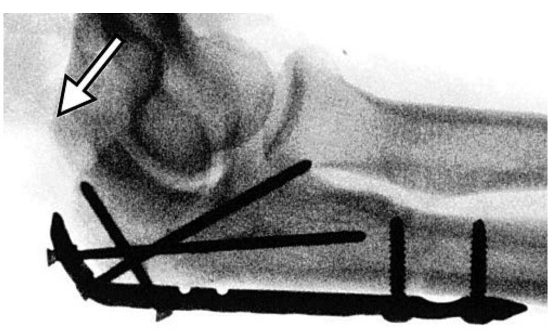

Figure 1. Location and direction of the additional "kickback" screw is shown by the white arrow on the radiograph. The standard group received the same screw pattern, but without the additional screw.

Results

The addition of the "kickback" screw increased the number of survived cycles and maximum load sustained in three out of four cases (Table 1). Briefly, the standard group survived an average of 128 cycles before failing at an average of 3.33kg, while the kickback group survived an average of 174 cycles before failing at an average of 3.83kg. There was no statistical difference between the groups in terms of cycles survived or maximum loads sustained. Three out of four samples from the standard treatment experienced gradual failure due to fracture displacement, while three out of four samples from the kickback group experienced catastrophic failure prior to 3mm of fracture displacement.

Table 1

Group	Specimen	Final Load (kg)	Final Cycle #	Failure mode
Standard	1	5.2	211	Catastrophic Failure
	2	2.2	90	>3mm Fracture Displacement
	3	4.7	211	>3mm Fracture Displacement
	4	1.2	1	>3mm Fracture Displacement
	Average	3.33	128	
Kickback	1	6.2	316	Catastrophic Failure
	2	3.7	174	Catastrophic Failure
	3	2.2	61	Catastrophic Failure
	4	3.2	144	>3mm Fracture Displacement
	Average	3.83	174	

Discussion and Conclusion

Although the results from this experiment do not reach statistical significance, we are encouraged by the improvements in survived cycles and sustained load in three out of four cases. Further, it is interesting that the "kickback" screw seems to mitigate the magnitude of relative bone fragment migration. These results reinforce our clinical decision to allow for early range of motion in patients with a "kickback" screw to allow for earlier return to activity. The study requires more samples in order to increase statistical power and therefore further tests will be conducted in the future to fully determine the utility of a "kickback" screw in olecranon repairs.