

Tension-band fixation of olecranon fractures

A cadaver study of elbow extension

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The loss of extension produced by tension-band wiring was studied using cadaveric elbows. Extension loss was found to be due to impingement of the longitudinal wires against the humerus independent of the tension band. Reducing the size of

the bent end of the longitudinal wire is recommended, and bending the wire into a loop achieves this. In addition, passing the tension band through the loops prevents the wire from backing out.

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We have studied the effect of several configurations of tension-band wiring on the range of extension of the intact cadaveric elbow.

Materials and methods

Thirteen cadaveric elbows were used. Each was mounted on a firm block, clamping the humeral shaft and epicondyles horizontally. An anterior soft-tissue release was performed to permit the elbow to fall, under the influence of gravity, to full extension.

Tension-band wiring was performed in each specimen using each of four configurations: a 10-mm and a 5-mm "leg" with a superficial tension band; a 10-mm and a 5-mm "leg" with a deep tension band, K-wires driven through the triceps; a 10-mm and a 5-mm "leg" placed superficially, but without a tension band; and a 5-mm diameter looped K-wire with a superficial tension band passed through the loops (Figure 1). The longitudinal K-wires were bent to

90° at one end and cut leaving a 5-mm or a 10-mm "leg," or were bent into a 5-mm-diameter loop. The wiring was inserted with the elbow flexed using the same drill holes in each case. The tension band was tightened at two sites, and the elbow was allowed to extend under the influence of gravity. Any loss of extension was measured with a goniometer. We confirmed that the elbow would return to its original position between insertion of different wiring configurations. The Students *t*-test was used.

Results

All the wiring configurations caused a loss of extension (Tables 1 and 2). The "leg" of the longitudinal K-wire when placed superficially pressed the triceps tendon against the posterior surface of the humerus, preventing full extension. For superficially placed K-wires, the extension loss was most marked with 10-mm legs and least so with looped K-wires (Table 1). This difference reached significance between the 10-mm legs and the loops ($P < 0.05$).

Placing the tension-band wire deep to the triceps produced less extension loss, but this only reached significance between the 10-mm "legs" ($P < 0.01$).

There was no difference in the loss of extension with and without superficially placed tension-band wires (Table 2).

Discussion

The extension loss appeared to be due to impingement of the longitudinal K-wires against the humerus, rather than tethering of the triceps tendon by the tension band. Placing the wiring deep to the

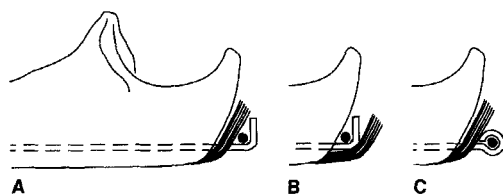


Figure 1. Configurations of tension-band wiring.

- A. 10-mm "leg" with a superficial tension band.
- B. A 10-mm "leg" with a deep tension band; K-wires driven through the triceps.
- C. A 5-mm-diameter looped K-wire with a superficial tension band passed through the loops.

Table 1. Mean loss of extension. Degrees SD

K-wire	Tension-band relation to triceps			
	Superficial		Deep	
10-mm "leg"	13.5	4.7	8.5	3.4
5-mm "leg"	8.9	3.5	6.8	4.3
Loops	5.6	3.1		

triceps reduced this impingement, but this only reached significance in the case of the 10-mm "legs."

Reduction of the length of the "leg" also attenuated extension loss; but, in the case of superficially placed wires, this only achieved significance between the 10-mm "legs" and the looped K-wires, and between the 5-mm "legs" and the loops. The looped K-wire causes little impingement and is comparable in diameter to that achieved by bending the wire into a "U" (Weber and Vasey 1963, Colton 1973). Passing the tension band through loops in the longitudinal wires (Montgomery 1986) has the advantage of preventing them from backing out, which has accounted for a complication rate of 10 percent in some series (Macko et al. 1985, Wolfgang et al. 1987). The looped K-wire modification of Netz's needles (Netz and Strömberg 1982) and a superficially placed tension band compared favorably in our study with deeply placed tension-band configurations; in addition, it involves a less extensive dissection than when placing a tension-band wire deep to the triceps. Further, wiring placed superficial to the triceps may be subsequently removed with less trauma to the tendon than deeply placed wiring.

If, when the wiring is placed superficially, the longitudinal wires are hammered against the olecranon before final tightening of the tension band, undue prominence may be avoided. Thus, in

Table 2. Mean loss of extension in degrees for superficially placed K-wires

K-wire	Tension band			t-test
	with	without		
10-mm "leg"	13	12		NS
5-mm "leg"	8.9	7.3		NS

conclusion, we feel that the use of looped superficial K-wires warrants further investigation in a clinical context.

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