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TRAUMA SURGERY

There is no difference in the complication or re-operation rates between tension band wiring and locking plate fixation for olecranon fractures. The findings of a multicentre study

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Abstract

Introduction Tension band wire (TBW) and locking plate fixation (LPF) are widely used fixation methods for displaced fractures of the olecranon. The aim of our study was to review the current operative management of olecranon fractures and compare the complication and re-operation rates for patients undergoing TBW and LPF.

Materials and methods Retrospective data were collected for all patients who underwent acute fixation of olecranon fractures in 2016 across nine hospitals in the United Kingdom. We reviewed these cases to determine the incidence of complications and re-operations.

Results One hundred and forty patients were included in the study. Seventy-three (52%) had TBW, 67 (48%) had LPF. Males were more likely to have LPF ($p=0.01$) as were patients with comminuted fractures ($p<0.01$). The overall complication rate was 25%, including an infection rate of 3%, a prominent metalwork irritation rate of 12% and the overall re-operation rate was 17%. There was no significant difference in the complication rate ($p=0.38$), infection rate ($p=0.92$) or rate of prominent metalwork irritation ($p=0.10$) between patients undergoing TBW and LPF. Sub group analysis of patients with comminuted fractures also demonstrated no significant difference in complication rates ($p=0.75$) or re-operation rates ($p=0.26$).

Conclusion LPF has previously been advocated to be advantageous to TBW due to lower reported complication and re-operation rates despite there being no significant difference in functional outcomes. In this multicentre case series, which is the largest in the literature to date, we did not observe any significant differences in complication rates or re-operation rates between the two, even amongst comminuted fractures (which are traditionally treated with LPF), when decision making was left to surgeon preference. We, therefore, recommend that choice of fixation method should be left to individual surgeon's preference.

Keywords Olecranon · Tension band wire · Locking plate

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Introduction

Fractures around the elbow are a frequently occurring injury with an incidence of around 7.5 per 10,000 [1]. Olecranon fractures are reported to account for up to 10% of all fractures around the elbow [2]. Whilst conservative management is indicated for the treatment of fractures with minimal displacement [3] or fractures in elderly, low demand patients [4–6], many of these injures will necessitate operative intervention. [7] Many methods of surgical fixation have been described with the most widely used being tension band wire fixation (TBW) and locking plate fixation (LPF). The mainstay of treatment for displaced olecranon fractures has traditionally been TBW with LPF reserved for fractures not amenable to TBW [8] such as those that are comminuted or

unstable [9–14]. In recent times however, LPF has become more popular.

Originally described in 1883 [15], TBW is regarded as the most commonly used method of fixation and is recommended for simple non comminuted, transverse fracture patterns [5, 15]. LPF with anatomically contoured locking plates has grown in popularity in recent years and is recommended for comminuted fractures and injury patterns where greater rotational stability is required [2, 5, 15].

When compared to LPF, TBW is relatively inexpensive; however, the current literature suggests that removal of metalwork, complication and re-operation rates is higher in patients undergoing TBW [5]. A Cochrane review in 2014 concluded that there was insufficient evidence to draw robust conclusions on the effects of surgical interventions for olecranon fractures and recommended that further trials should be conducted with systematic assessment of complications and further treatment including routine removal of metalwork [16].

The aim or our study was to retrospectively review the current operative management and compare complication and re-operation rates for patients undergoing TBW and LPF for olecranon fractures.

Materials and methods

Retrospective data were collected for all patients who underwent surgery for fixation of olecranon fractures in 2016 (1st January to 31st December) across nine hospitals in the United Kingdom. Patients who were lost to follow up, patients with other associated fracture around the elbow, patients who underwent fixation at greater than 6 weeks following injury, patients aged under 16 at time of injury and patients who underwent any procedure other than TBW of LPF were excluded from the study. Open fractures were not excluded from the study. Seventeen patients were excluded from the study. Demographic data, Mayo classification [17], method of fixation, the incidence of a complication and the event of re-operation were recorded. Complications were recorded as infection or prominent metalwork irritation. Any other complications occurring were reported as other. Re-operation included any return to theatre during the follow up period, this was recorded as either; wound irrigation or debridement, removal of metalwork, revision surgery or other. Revision surgery was defined as any procedure where fixation was revised. All data were collected form retrospective review of clinical documentation. Data were recorded and analysed using Microsoft Excel and statistical analysis was performed. Data were presented as means ± standard deviation. Age and was compared using a two-tailed *T* test. Gender, fracture types complication rates and re-operation rates were compared using a chi squared test and Fishers exact test. Significance was reported to a level of $p < 0.05$. The study was registered and approved at each participating hospital.

Results

Demographics

Following application of the exclusion criteria 140 patients who underwent surgery for fixation of olecranon fractures were reviewed. This comprised 82 males (59%) and 58 females (41%). The mean age of all patients was 54.71 years (Range 16.17–88.8 SD 20.05). The mean age of male patients (47.21 years, range 16.17–88.52, SD 19.17) was significantly lower ($p < 0.01$) than the mean age for female patients (65.33 years, range18.48–88.68, SD 16.19). Mean follow up duration was 195 days (range 12–995 days) although all clinical notes were reviewed after 1 year, from time of injury, to identify any further complications or treatment amongst patients who had already been discharged. 10 patients were lost to follow up.

Simple (non comminuted) fractures accounted for 78 (56%) cases whilst 62 (44%) patients had comminuted fractures. Males were more likely to have comminuted fractures with 52% of males having comminuted fractures compared to 33% of females ($p = 0.03$). Distributions of fracture type are shown in Table 1. There was no significant difference ($p = 0.43$) in the mean age of patients with simple fractures (55.91 years, SD 20.9) and the mean age of patients with comminuted fractures (53.21 years, SD 18.97).

Table 1 Distribution of fractures by the Mayo classification and description of the classification system

Mayo Classification		Number of patients
Type 1	Undisplaced	13 (9%)
Type 2A	Displaced, non comminuted with stable ulnohumeral joint	65 (46%)
Type 2B	Displaced with stable ulnohumeral joint, comminuted	48 (34%)
Type 3A	Displaced with stable ulnohumeral joint, comminuted	6 (4%)
Type 3B	Displaced with unstable ulnohumeral joint, comminuted	8 (6%)

Treatment

Mean time to surgery was 5 days (range 0–33 days). TBW was performed in 73 (52%) patients, 67 (48%) patients underwent LPF. Males were more likely to have LPF (57%) than females (34%) ($p=0.01$). Patients with comminuted fractures were more likely to have LPF ($p<0.01$), with 74% having LPF compared to 21% of patients with simple fractures. There was no significant difference ($p=0.34$) in age between patients who had TBW (57.13 years) and LPF (52.08 years).

Outcomes

Complications were reported in 35 (25%) patients. Infection was reported in 4 (3%) patients, prominent metalwork irritation in 17 (12%) patients and other complications were reported in 15 (11%) patients (this included; inadequate fixation, woundcare problems not associated with infection, swelling and loss of fracture reduction). One patient suffered more than one complication. There was no significant difference in overall complication rate ($p=0.38$), infection rate ($p=0.92$) or patients complaining of prominent metalwork irritation ($p=0.10$) between patients undergoing TBW and those undergoing LPF (see Table 2). There was also no significant difference ($p=0.584$) in overall complication rates between males (24%) and females (26%).

In this cohort 23 (16%) patients underwent further surgery including 2 (1%) wound irrigation and debridement, 16 (11%) removal of metalwork and 4 (3%) cases of revision surgery, two patient had another procedure (excision of olecranon bursa) and one patient underwent more than one procedure. There was no significant difference in the proportion of patients requiring any further surgery ($p=0.55$) or removal of prominent metal ($p=0.68$) between the two groups (see Table 2). There was also no significant difference ($p=0.67$) in the proportion of patients requiring further surgery between males (18%) or females (16%).

Subgroup analysis was performed considering only comminuted fractures. There was no significant difference in complication rates ($p=0.75$) for fractures treated with TBW (25%) compared to LPF (33%) in these patients. Nor was there a difference in rates of patients complaining of irritation ($p=1$) for comminuted fractures fixed with TBW (13%) compared to comminuted fractures fixed with LPF (15%). There was also no significant difference in proportion of patients requiring further surgery ($p=0.26$) for comminuted fractures fixed with TBW (6%) compared to comminuted fractures fixed with LPF (22%).

Discussion

In this study, which aimed to comparatively report the complication and re-operation between TBW and LPF in the management of features of the olecranon, we found there to be no significant difference.

Multiple studies have compared outcomes following TBW and LPF demonstrating no difference in DASH score, range of movement, Mayo elbow score, Broberg and Morrey score, improvement rate or blood loss or time to achieve union [13, 18, 19]. Reported benefits of the use of TBW over LPF is a reduced operation time [20, 24] and lower procedure and implant costs [20, 21]. Francis et al. found TBW to be more cost-effective than LPF despite the higher rate of return to theatre for Mayo type II fractures [22, 25].

When comparing complications and re-operation rates, the current literature suggests that LPF is superior. Complication rates are reported to be between 17–23% for LPF compared to 40–48% for TBW whilst re-operations rates for LPF reported to be between 6–27% for LPF compared to 20–46% for TBW [20–26] However in our case series we demonstrated a complication rate of 28% and 22% and re-operation rate of 15% and 19% for LPF vs TBW respectively, this is contrary to the published literature as we did not observe any significant difference between the two procedures.

The majority of re-operations and the complications in the literature are attributed to patient complaint of prominent metal work (42–61%) [23, 24]; however, these studies fail to report prominence of metal work in LPF. This complaint of prominent metal work does not necessitate the removal of such, as some studies have even demonstrated a rate of 62.8% metalwork prominence with only 18% requiring removal. [26] We observed a much lower rate of

Table 2 Complication and re-operation rates for TBW vs LPF

	LPF	TBW		Males	Females	
Complication (any)	19 (28%)	16 (22%)	*p=0.38*	20 (20%)	15 (18%)	*p=0.87*
Infection	2 (3%)	2 (3%)	*p=0.92*	–	–	–
Prominent metal Irritation	5 (7%)	12 (16%)	*p=0.10*	–	–	–
Re-operation (any)	10 (15%)	14 (19%)	*p=0.55*	15 (18%)	9 (16%)	*p=0.67*
Removal of metal	7 (10%)	9 (12%)	*p=0.68*	–	–	–

LPF locking plate fixation, *TBW* Tension band wire, statistical analysis using Fishers exact test

patients complaining of prominent metalwork (12%) but a similar rate of removal of metalwork (11%).

Contrary to findings in the current literature, we demonstrate no difference in complication and reoperation rated between TBW and LPF even when used form comminuted fractures; however, no studies have been performed with a patient cohort a large as ours or across as large a hospital group [8, 18, 21, 23]. One potential reason for this would be regional familiarity with implants and training trends, i.e. all our hospitals were within the same geographic region of the United Kingdom. Within which there may be a greater familiarity with TBW techniques thereby resulting in lower complications than previously described in the literature.

The limitations of this study include the retrospective nature of data collection. We recognise that such studies are susceptible to selection bias as indicated by the fact that 74% of patients with comminuted fractures underwent LPF, this may have led to an overall reduction observed complication and re-operation rates. This does not, however, account for the lower complication or re-operation rate reported when TBW was used in such comminuted cases. Lack or randomisation meant that decisions about fixation method were based on surgeons' preference. We are therefore only able to conclude that there is no difference in outcomes when decision making is left to surgeons' preference. We are still able to make useful comparisons between the two fixation methods, as both TBW and LPF were used for fracture types for which they are not traditionally recommended. However larger prospective randomised studies are required. Our study also failed to look at functional outcomes, although these are well reported in the literature. We also recognise that our study would me more informative with more detailed clinical information regarding the indications for removal of implants, incidence of loss of fracture reduction, presence of neurological impairment following surgery, incidence of progression to union and metalwork failure, differentiation between superficial and deep infections or time to complication.

Furthermore, novel techniques for fixation that this study has not reviewed, may offer superior outcomes with regards to complication and re-operation rate. Following the development of low profile plates and experience in double plating of long bone fractures, the use of such in the olecranon may represent a middle ground without the complications previously attributed to TBW or traditional LPF. Hoelscher-Doht et al. reported double plating with low profile plates to be biomechanically similar in terms of load to failure [27]. In addition, the Tension Band Plate is now an option in the management of such fractures with a cadaveric study noting similar stability in oblique and unstable fracture configurations when comparing to traditional TBW techniques These lower profile plates may herald improved results through minimising soft tissue irritation and warrant further investigation in vivo [28].

Conclusion

LPF has previously been advocated to be advantageous to TBW fixation due to a lower reported complication and re-operation rate, being recommended for even more simple fractures, despite no difference in functional outcomes. In this multicentre case series, which is the largest in the literature to date, we did not observe any statistically significant differences in complication rates or re-operation rates between the two, even amongst comminuted fractures (which are traditionally treated with LPF), when decision making was left to surgeon preference. We therefore cannot recommend either fixation method over the other and advocate that choice of fixation method should be left to individual surgeon's preference.

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Declarations

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