

Buried versus un-buried Kirschner wires following fixation of hand fractures: a national clinician and patient survey

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Abstract

Introduction

Fractures of the hand are common and typically affect men of working age.¹⁻³ A range of management options are available, with open or closed fracture reduction and Kirschner wire (K-wire) fixation being one of the mainstays of treatment. Once placed with either open or closed reduction, K-wires the free end is either cut long to remain exposed proud of the skin (non-buried) or cut short such that the skin is closed over the end (buried). The perceived advantages of burying wires include assumed greater patient comfort, reduced infection rate, earlier mobilisation, and as a result, the ability to leave the wires in place longer. The main disadvantage is wire removal, which requires a second operative procedure, usually under local anaesthetic in the operating theatre. This is inconvenient for patients and has financial implications for both them and the health service. A recent systematic review has found no substantial evidence to guide clinicians on whether K-wires should be buried following fracture fixation in the upper extremity with regards to post-operative infection or other outcomes. The aim of this national survey is to establish current practice, and to understand the patient and clinician perspectives of the key factors influencing the decision to bury the wire or not.

Methods

This study was carried out via the Reconstructive Surgery Trials Network (RSTN), a national collaborative surgical research body based in the UK. Through the RSTN, we performed a national collaborative online survey of consultants and junior surgeons in plastic and orthopaedic hand units, hand therapists and patients at all 52 hand surgery units across the UK. An innovative collaborator approach was used to conduct this study, where a named study collaborator was found for each hand unit and was responsible for collecting data for their unit from clinicians and patients. Each collaborator that achieved the requirements for data collection is included as an author.

The clinician surveys were designed by the study steering group, examining unit and personal preferences for buried versus un-buried K-wires along with related practice and decision-making factors (appendix 1 and 2). In order to be representative of a unit's preference, the collaborator was asked to ensure over 95% of clinicians completed the survey. The collaborator identified 10 patients that had undergone K-wire fixation of one or more metacarpo-phalangeal fractures (appendix 3) and collected patient-related survey data. The surveys were created and carried out using RedCap (ref).

Statistical Analysis

Descriptive analysis was performed for all survey outcomes. For categorical data, contingency tables were built. As these were expected to comprise some cells with low numbers, they were analysed using Fisher's exact test. The association between variables and surgeons' preference to bury or not bury K-wires was studied by calculating raw odds ratios (ORs) describing the effect of a single unit incremental increase (using the 1-9 scales of importance in the survey) in the subjective importance placed on the variable and surgeons' preferences. All variables were entered as covariates in a multinomial logistic regression model.

To control for false positive associations, a described method was used to adjust the p value threshold considered significant for each covariate in an analysis (Benjamini and Hochberg, 1995). An *a priori* false discovery rate (Q) of 20% was adopted. The covariates in the model were ordered by p

value and each covariate's p value threshold was calculated using the formula $(i/m)*Q$, where 'i' was the rank of the covariate by p value and 'm' was the total number of tests (12 in each analysis). If the p value obtained for a covariate was smaller than both 0.05 and the calculated threshold for the covariate, the result was considered significant.

All statistical analyses were performed using SPSS.

Results

We received 797 responses from a total of 423 surgeons, 187 hand therapists and 187 from 52 hand surgery units nationwide (Figure 1). **Need to clarify total denominator numbers for response rate.** X number of surveys were completed by plastic surgery consultants, X by orthopaedic surgery consultants, X by plastic surgery registrars and X by orthopaedic registrars. X hand therapists completed the survey. We received X patient surveys out of a potential 520, giving a response rate of X.

Most surgeons expressed “no preference”, rather than preferring ORIF or K-wiring, though more orthopaedic surgeons had no preference compared to plastic surgeons (64/77 (83%) of orthopaedic surgeons specified “no preference”, versus 249/321 (77%) of plastic surgeons, $p < 0.001$ between specialties (Fisher’s exact test)). This was also reflected in consultant surgeon versus junior surgeon preference (88% and 69% expressed “no preference” for fixation type respectively). Greater proportions of plastic surgeons and junior surgeons preferred K-wiring: one in four junior surgeons preferred K-wires for hand fractures. Overall, few preferred ORIF to K-wires regardless of seniority or specialty (3.7-11.7%).

Most plastic surgeons expressed a preference to leave K-wires un-buried (170/321, 53%) with 34% reporting no preference. In contrast, 49% of orthopaedic surgeons expressed no preference, with 41% preferring to not bury the wire. Only 13% of plastic surgeons and 10% of orthopaedic surgeons preferred to bury wires. The majority of junior surgeons preferred to leave the wires un-buried (59.3%) whereas the consultant body was divided between un-buried wires (42%) and no preference (44%). (Table 1)

The multivariate analysis demonstrated good model fit (Chi-square: 143.2, 24 degrees of freedom, $p < 0.001$; Pearson goodness of fit $p = 0.997$; and a receiver operating characteristic curve of the multivariate model’s ability to predict a preference to bury had an area under the curve of 0.867).

When the univariate and multivariate ORs were compared (see tables 4 and 5), confounding between variables was seen, as six variables that had significant univariate ORs became non-significant in the multivariate model. This confirmed the value of the multivariate model.

As greater importance was placed on the risk of pin site infection, the odds of preferring to bury K-wires increased (adjusted OR 1.50, $p=0.013$, for preferring to bury wires for each single-unit increase in the importance placed on pin-site infection).

Conversely, placing increasing importance on the ease of K-wire removal was associated with a decrease in the odds ratio of preferring to bury K-wires (adjusted OR 0.73, $p=0.003$ for each single-unit increase in the importance placed on ease of K-wire removal). Similarly, each single-unit increase in the importance placed on the ease of K-wire removal was associated with a significant increase in the odds of preferring not to bury (adjusted OR 1.39, $p<0.001$). (Table 5)

One further covariate was close to reaching significance. The association between the importance placed on the final cosmesis and preferring not to bury K-wires had a p value under 0.05 (OR 1.20, $p=0.034$), but this was not below the calculated p value threshold, and so in this analysis was considered to be a type two error.

Antibiotic usage

Removal time – phalangeal versus metacarpal

Follow-up time

Need Hand Therapy (Table 6) and Patient Survey (Table 7) results and analyses here.

Discussion

Present study findings

In a multivariate analysis, this is the case with all other covariates controlled for in the model, i.e. the above effect occurred independently of whether the individual was concerned about the risk of bone infection, pain, ease of dressing change, etc.

Comparison to existing literature

Limitations

There are some limitations to this study's methods. The sample size was restricted by the number of UK hand surgeons. This study aimed to describe UK NHS practice, and so was not extended to other countries. The "event rate", which in this case was the preference to bury K-wires, was lower than had been anticipated. As traditional convention suggests that studies should have 10 events per covariate (Peduzzi et al., 1996), the regression analysis performed in the present study might be considered underpowered. However, the validity of this heuristic has been challenged, and lower event rate:covariate ratios may be acceptable. (Vittinghoff and McCulloch, 2006) The other option would have been to only analyse a restricted number of covariates, or to generate a parsimonious set using stepwise methods. Neither of these options were considered appropriate for an exploratory study. Instead, we accept the potential for underpowering and overfitting in this study, and would advocate further mixed methods study of decision-making about K-wire management. Our ordinal scales of variables were treated as covariates in the regression analysis rather than as factors, despite not having interval-level measurement properties demonstrated. In the absence of clear *a priori* hypotheses about cut offs in the scales, and a desire to avoid exacerbating potential underpowering, this was considered reasonable.