



# Treatment of acute distal biceps tendon ruptures – A survey of the British Elbow and Shoulder Society surgical membership

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## Abstract

**Background:** Acute distal biceps tendon ruptures result in weakness and deformity. While in other jurisdictions the rate of surgical repair has outpaced rises in incidence, UK practice for distal biceps tendon ruptures is unknown. The aim of this survey was to characterise current UK clinical practice.

**Methods:** An online survey was sent to the surgeon members of the British Elbow and Shoulder Society. Questions covered respondent demographics, clinical decision making, surgical experience and willingness to be involved in future research.

**Results:** A total of 242 surgeons responded; 99% undertook acute distal biceps tendon repairs with 83% repairing at least half of all distal biceps tendon ruptures, and 84% of surgeons would have their own, hypothetical, acute distal biceps tendon rupture repaired in their dominant arm and 67% for their non-dominant arm. Patient age, occupation and restoration of strength were the commonest factors underpinning a recommendation of surgical fixation. Most surgeons (87%) supported a national trial to study operative and non-operative treatments.

**Conclusions:** UK upper limb surgeons currently advise surgical repair of acute distal biceps tendon ruptures for the majority of their patients. This is despite a paucity of evidence to support improved outcomes following surgical, rather than non-operative, management. There is a clear need for robust clinical evaluation in this area.

## Keywords

Distal biceps tendon, tendon rupture, survey

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## Background

Acute distal biceps tendon (DBT) ruptures can be a debilitating injury causing pain, weakness and an altered biceps contour.<sup>1</sup> Historically, they have been considered to be a relatively uncommon injury occurring in the dominant arm of otherwise healthy middle-aged men.<sup>2</sup> However, with increasing sporting participation and more active elderly populations, the incidence and age at presentation are expected to rise. Indeed, between 2001 and 2016, the incidence of DBT ruptures rose 6-fold among Swedish men.<sup>3</sup> Despite a lack of clinical consensus on the role of operative treatment, rates of surgical repair rose 28-fold in the same cohort.<sup>3</sup> Support for surgical repair has largely been

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driven by biomechanical studies that report a reduction in supination and elbow flexion strength, as well as impaired endurance in injuries managed non-operatively.<sup>4,5</sup> Currently available studies investigating patient reported outcomes are noted to be at risk of selection bias and potentially conflicted.<sup>6</sup> Proponents of non-operative treatment cite concerns over serious operative complications, including nerve injury, radial neck fracture and heterotopic ossification (HO), and question the functional deficit conveyed by the biomechanical weakness identified on testing.<sup>7</sup>

In the UK, it is unclear what the current practice is regarding acute distal biceps ruptures. The aim of this survey was to identify current UK clinical practice, gather information on the factors that influence surgeon treatment choice and to ascertain the degree of support amongst shoulder and elbow surgeons for future research into the treatment of acute DBT ruptures.

## Methods

### *Administration of survey*

Surgical members of the British Elbow and Shoulder Society (BESS) were invited via email to participate in an online survey prepared using the Bristol Online Survey system. Information about the aims of the survey and a hyperlink to the survey was provided. The survey was designed to take approximately 10 min to complete. There was no minimum number of responses required, as the study was opportunistic in terms of sample size and not driven by statistical testing. The response rate was defined as the number of responding participants divided by the number of eligible people invited. The statistical analysis was descriptive only. Responses were summarised quantitatively or narratively, as appropriate (using Microsoft Excel (Version 16.12) and Prism (Version 7.0)). No attempt was made to validate individual responses.

The email invitation was sent out on 17 June 2020, a further reminder email sent on 19 August 2020 and the survey closed on 31 October 2020. This was a voluntary survey of health care professionals and therefore formal ethical review was not sought. However, the survey was approved by the BESS Research Committee. A formal consenting process was not undertaken, rather completion of the survey was taken as implied consent. All responses were anonymous.

### *Survey contents*

To assess respondent demographics, we asked about participant grade, place of work and age. To determine the degree of exposure to acute DBT repairs, we asked

respondents to provide the total number of repairs performed annually and to estimate the percentage of acute DBT tears they typically repaired. For surgeons who did not perform repairs, the factors underlying this were explored.

The next section sought to investigate the pre-operative work-up of patients with acute DBT tears. Respondents were asked about investigations routinely used in diagnosis, decision making with regard to musculotendinous tears and whether decision making patient information leaflets were available. Surgeons were then asked about preferred surgical technique for repairs – the type of incision used and the type of bone–tendon fixation method.

To address the controversies surrounding patient selection for acute DBT repair, we asked respondents to rank the three most important factors leading to a recommendation for surgery or non-surgical treatment. In a hypothetical scenario, we asked if the responding surgeon would have their own acute DBT rupture surgically repaired in their dominant and non-dominant arm.

To investigate differences in post-operative rehabilitation, we asked whether chemical prophylaxis to prevent HO was routinely prescribed, whether a cast/splint/brace was utilised and for what duration, and if arm strength was routinely measured after rehabilitation.

Finally, respondents were then asked to consider the utility of future research into the treatment of acute DBT ruptures, including whether a national trial investigating operative vs. non-operative treatments would be useful, what their preferred study design would be and whether a nationally produced patient information resource would be valuable.

Within our collaborative, we piloted our survey on four members of the shoulder and elbow surgical community who perform acute DBT repairs.

A copy of the survey can be found in the online supplementary information (supplementary file 1).

## Results

### *Characteristics of the respondents*

A total of 636 surgical members of BESS were invited to participate with 242 (39%) responding. The respondents were mostly consultant surgeons (95%). There was a slightly larger proportion working at district general hospitals (48%) than University Teaching Hospitals (39%) (Table 1). The median age of respondents was 47 (range 33–75). Most participants (90%) worked within the National Health Service but with 27% reporting additional work within the private sector.

**Table 1.** Training grade and place of work of respondents.

Category	n	n (%)
Training grade	242	
Consultant		230 (95)
Associate specialist		2 (1)
Orthopaedic trainee/Fellow		10 (4)
Place of work	242	
District general hospital (DGH)		115 (48)
Teaching hospital		95 (39)
Mixed – DGH + teaching hospitals		7 (3)
Private hospital		23 (10)
Other		2 (1)

### Surgical experience with distal biceps tendon repairs

Almost all respondents undertook acute DBT repairs (99%) with all of those not undertaking repairs asking colleagues to do so on their behalf (Table 2). Of interest no respondent routinely felt that surgical repair was unnecessary. When asked to estimate the percentage of acute DBT ruptures they surgically repaired, 83% reported repairing at least half of all cases. A varied surgical experience in biceps repairs was reported, ranging from 0 to 50 procedures annually. However, most surgeons reported a lower volume, with 93% undertaking fewer than 15 repairs annually.

### Clinical decision making

Over half of surgeons routinely use imaging in the diagnosis of acute distal biceps ruptures (ultrasound (31%), Magnetic Resonance Imaging (MRI) (24%)) (Table 3). Further details were provided by 8 (3%) respondents with most (n=5) reporting the use of radiological investigations only when clinical uncertainty remained. If a musculotendinous tear was diagnosed on imaging, or at the time of surgery, almost half (48%) felt repair was not possible, while approximately one quarter (26%) would undertake a direct suture repair and 15% would augment the repair with a biomaterial. Twenty-seven participants provided free text answers with two dominant themes emerging – 48% felt that musculotendinous tears were not part of their practice and a further 19% made a distinction between pre-operative and intra-operative diagnosis, repairing only the latter.

**Table 2.** Surgeon-reported practice for DBT ruptures.

Question	n	n (%)
Do you repair acute DBT ruptures?	242	
Yes		239 (99)
No		3 (1)
What is your primary reason for not repairing DBT ruptures?	3	
My colleagues undertake these cases on my behalf		3 (100)
I don't believe it is necessary in the vast majority of patients		0 (0)
What percentage of acute DBT ruptures do you repair?	239	
0–24%		9 (4)
25–49%		31 (13)
50–74%		73 (31)
74–100%		126 (53)
On average, how many repairs do you perform annually?	239	
0–4		58 (24)
5–9		111 (46)
10–14		53 (22)
15–19		10 (4)
>15		5 (2)

DBT: distal biceps tendon.

The majority (84%) of surgeons would have a repair of an acute distal biceps tear in their dominant arm and 67% for their non-dominant arm. When asked to provide the top three factors influencing a recommendation to undertake surgical fixation, the patient's occupation (91%), age (86%) and restoration of strength (71%) were the most commonly reported factors (Figure 1). Conversely, consideration of hand dominance (26%), avoidance of cramps (18%) and cosmesis (8%) were of less importance to surgeons during clinical decision making. When recommending the non-surgical management of acute distal biceps ruptures, 95% of surgeons reported that the age of the patient was an important feature (Figure 2). Concerns over neurological injury (48%), rehabilitation duration (56%), anaesthetic risk (42%) and re-tear risk (26%) also

**Table 3.** Clinical decision making for acute DBT ruptures.

Question	n	n (%)
To confirm the diagnosis of DBT rupture do you routinely use:	242	
Ultrasound		75 (31)
MRI		58 (24)
Clinical diagnosis only		103 (43)
Other	6	
Imaging if residual diagnostic uncertainty		5 (83)
Either MRI or USS		1 (17)
If faced with a musculotendinous tear on imaging, or at surgery, what would you typically do?	242	
Advice repair is not possible		115 (48)
Repair using a direct suture technique		63 (26)
Repair using an autograft or allograft		30 (12)
Repair using a synthetic augment		7 (3)
Other	27	
Not part of my practice		13 (48)
Pre-op diagnosis = conservative, intra-op = suture repair		5 (19)
Let the patient decide		2 (7)
Dependent on patient's age		2 (7)
Suture to brachialis		1 (4)
No detail provided		2 (7)

DBT: distal biceps tendon; MRI: Magnetic Resonance Imaging; USS: Ultrasound Scan.

emerged as important factors influencing the non-operative decision-making process. Only 11% of respondents reported access to a patient-directed information sheet to aid joint decision making.

### *Surgical technique and post-operative protocols*

The frequency of surgical technique reported is presented in Table 4. A single longitudinal (42%) or horizontal (37%) incision were the most commonly used

surgical approaches, with two-thirds of surgeons using a cortical button as the preferred method of bone-tendon fixation.

Only 6% of surgeons prescribed chemical prophylaxis with the aim of preventing HO (Table 5). All of those prescribing chemical prophylaxis reported prescribing a non-steroidal anti-inflammatory drug. A minority of respondents (43%) prescribed a cast or brace/splint in the post-operative period. Of those who routinely recommend post-operative immobilisation, 17% prescribe a cast only for on average of two weeks (range 1–6 weeks), 42% a brace only for six weeks (range 2–12 weeks) and 41% a cast/brace combination for on average of two weeks (range 1–6 weeks) in cast and a further four weeks (range 2–8 weeks) in brace.

### *Future research*

When asked about a future national trial to study the safety, efficacy and cost effectiveness of operative and non-operative distal biceps repair 86% thought this would be useful (Table 6). Just over half (53%) would actively participate in an observational study, 31% would recruit to a randomised controlled trial (RCT) of operative vs. non-operative repair and 13% would participate in either study design. Ten respondents provided additional comments that explored barriers to participation. For three surgeons the proximity to retirement was a concern, two participants did not want to be involved in any future trial and a further two respondents suggested mixed methods research. For example, 'Randomised ideally but with observational arm for patient's not wanting randomisation'.

### **Discussion**

The incidence of acute distal biceps ruptures and the popularity of surgical repair both appear to be increasing.<sup>3,8</sup> We carried out a survey of surgical society membership to assess current diagnostic, surgical and post-operative practice for acute distal biceps repairs.

The majority of UK respondents undertake the surgical repair of acute distal biceps ruptures and do so in the majority of patients, mirroring the rising trend towards operative intervention observed in other countries.<sup>3</sup> A large proportion of surgeons would also have their own, hypothetical, DBT repaired in their dominant arm. Interestingly, a smaller proportion would have their non-dominant distal biceps repaired, yet handedness did not rank among the top three clinical variables influencing a recommendation of surgery to patients. Similarly, a previous study among orthopaedic surgeons found differences between personal treatment preferences and those recommended to patients.<sup>9</sup> In

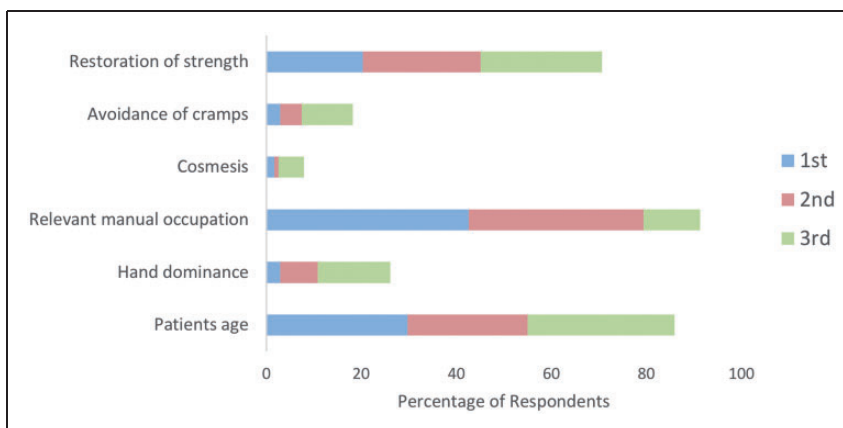


Figure 1. Ranking of the three most important features influencing a recommendation for surgery.

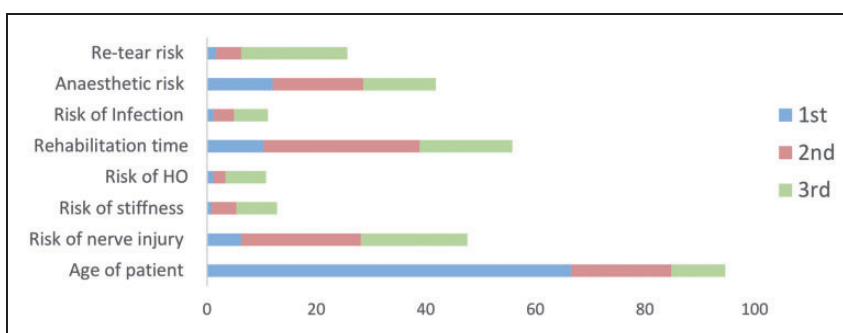


Figure 2. Ranking of the three most important features influencing a recommendation for non-operative management.

Table 4. Surgical technique for distal biceps repair.

Category	n	n (%)
Type of incision	239	
Single longitudinal		99 (42)
Single horizontal		88 (37)
Double incision		31 (13)
Other	21 (9)	
‘Lazy S’ incision		12 (57)
‘L-shaped’ incision		3 (11)
Single oblique incision		3 (11)
Case dependant		3 (11)
Bone-tendon fixation method	239	
Cortical button		159 (67)
Anchors		49 (21)

(continued)

Table 4. Continued

Category	n	n (%)
Trans-osseous suture		17 (7)
Other	14	
Interference screw + cortical button		14 (100)

part, this can be explained by a better appreciation of their own occupational, sporting and social factors and highlights the importance of shared decision making when discussing treatment options.

Overall, the majority of surgeons relied on Ultrasound (US) or MRI to confirm a diagnosis of distal biceps rupture. Despite a reported sensitivity of 83–100% for the hook-test<sup>10,11</sup> and 95% accuracy for the biceps squeeze test,<sup>12</sup> less than half would depend solely on clinical diagnosis.

Despite widespread support for surgical intervention, our survey has also highlighted that concern over serious complications, in particular nerve injury, influences a recommendation for non-operative

**Table 5.** Post-operative protocol for distal biceps repair.

Category	n	n (%)
Do you give chemical prophylaxis to prevent heterotopic ossification?	242	
Yes		14 (6)
No		228 (94)
Do you put your acute biceps repairs in a cast/brace/splint post-operatively?	241	
Yes		103 (43)
Cast only		18 (17)
Brace/splint only		43 (42)
Cast and brace/splint		42 (41)
No		138 (57)

management. This position was historically advocated by Robert Dobbie who was ‘thoroughly convinced that exposure of the tubercle was impractical and unwise’.<sup>13</sup> Recent meta-analyses have confirmed an overall high rate of complications (20–28%), with neuropraxia of the lateral antebrachial cutaneous nerve (9%) and HO (3%) particularly common, while permanent motor deficits of the radial, posterior interosseous and anterior interosseous nerves appear to be uncommon.<sup>7,14</sup> In light of these risks, the surgical community has an ethical obligation to provide robust evidence that operative management outweighs the risk of harm. Unfortunately, the current research landscape is limited to a small number of retrospective case series<sup>6</sup> with the only prospective trial to date subsequently withdrawn from publication.<sup>15</sup>

As with all survey-based data collection, there is potential for a response bias and the survey frame potentially also limits the generalisability of the findings of this survey – soft tissue elbow surgery also being undertaken by a proportion of hand surgeons or general trauma surgeons not represented in the BESS membership. The achieved response rate was low, although it was not that dissimilar from that achieved in similar surveys of the BESS surgical membership.<sup>16,17</sup> BESS members, and in particular those who are more likely to respond to a survey, are not necessarily representative of the wider upper limb surgical community and may include more research-oriented surgeons.

**Table 6.** Role of research in acute distal biceps repairs.

Category	n	n (%)
How useful would you find a national trial to study the safety, efficacy and cost-effectiveness of operative and non-operative treatments?	242	
Extremely		117 (48)
Quite		92 (38)
Not very		28 (12)
Useless		5 (2)
If a trial to investigate safety, efficacy and cost effectiveness were proposed, which study design might you consider participating in?	239	
Randomised – operative vs. non-operative		74 (31)
Observational study		126 (53)
Either randomised or observational		32 (13)
Other		7 (3)

Despite the aforementioned limitations, a strong theme from the respondents was the need for robust multi-centre clinical trials, with greatest support for an observational study investigating the safety, efficacy and cost effectiveness of operative and non-operative treatments for acute distal biceps ruptures. Clearly, in any future trial it is important that the study protocol does not discourage surgeons from recruiting. This survey has highlighted a diverse range of surgical incisions, fixation methods and post-operative protocols, offering support for a broad, pragmatic, methodological approach towards surgical technique and post-operative immobilisation.

## Conclusions

Amongst UK upper limb surgeons who responded to this survey, the surgical repair of acute distal biceps ruptures is widely adopted, and while the majority of patients are offered operative repair. Patient age, occupation and restoration of strength were the most important factors driving a recommendation of operative management. There is currently a paucity of

evidence to support the surgical repair of acute distal biceps ruptures with survey participants expressing support for a future observational or randomised control trial assessing the safety, efficacy and cost-effectiveness of operative treatment.

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### Ethical Review and Patient consent

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### Guarantor

Senior author – SEG.

### Contributorship

All authors contributed equally to survey design and manuscript preparation. The authors MJB and SEG undertook data collection, extraction and analysis. All work was overseen by the author SEG.

### Availability of data + material

The dataset used and/or analysed during the current study is available from the corresponding author on reasonable request.

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### Supplemental material

Supplemental material for this article is available online.

### References

- Rubinger L, Solow M, Johal H, Al-Asiri J. Return to work following a distal biceps repair: a systematic review of the literature. *J Shoulder Elb Surg [Internet]* 2020; 29(5): 1002–1009.
- Safran MR, Graham SM. Distal biceps tendon ruptures: Incidence, demographics, and the effect of smoking. *Clin Orthop Relat Res* 2002; (404): 275–283.
- Launonen AP, Huttunen TT, Lepola V, Niemi ST, Kannus P, Fellnder-Tsai L, Berg HE, Laitinen MK, Mattila VM. Distal Biceps Tendon Rupture Surgery: Changing Incidence in Finnish and Swedish Men Between 1997 and 2016. *J Hand Surg Am [Internet]* 2020; 45(11): 1022–1028.
- Morrey BF, Askew LJ, An KN, Dobyns JH. Rupture of the distal tendon of the biceps brachii. A biomechanical study. *J Bone Jt Surg – Ser A* 1985; 67(3): 418–421.
- Freeman CR, McCormick KR, Mahoney D, Baratz M, Lubahn JD. Nonoperative treatment of distal biceps tendon ruptures compared with a historical control group. *J Bone Jt Surg – Ser A* 2009; 91(10): 2329–2234.
- Qureshi MK, Khaled AS, Elgindi AO, Mastan S, Jeyam M. Operative versus non-operative management of distal biceps brachii tendon rupture: A systematic review. *Muscles Ligaments Tendons J* 2020; 10(4): 678–685.
- Amarasooriya M, Bain GI, Roper T, Bryant K, Iqbal K, Phadnis J. Complications After Distal Biceps Tendon Repair: A Systematic Review. *Am J Sports Med* 2020; 48(12): 3103–3111.
- Kelly MP, Perkinson SG, Ablove RH, Tueting JL. Distal Biceps Tendon Ruptures: An Epidemiological Analysis Using a Large Population Database. *Am J Sports Med* 2015; 43(8): 2012–2017.
- Janssen SJ, Teunis T, Guitton TG, Ring D, Spoor AB, Chauhan A, Shafritz AB, Wasterlain A, Terrono AL, Neviasser AS, et al. Do surgeons treat their patients like they would treat themselves? *Clin Orthop Relat Res* 2015; 473(11): 3564–3572.
- O Driscoll SW, Goncalves LBJ, Dietz P. The hook test for distal biceps tendon avulsion. *Am J Sports Med* 2007; 35(11): 1865–1869.
- Luokkala T, Siddharthan SK, Karjalainen T V., Watts AC. Distal biceps hook test Sensitivity in acute and chronic tears and ability to predict the need for graft reconstruction. *Shoulder Elb* 2020; 12(4): 294–298.
- Ruland RT, Dunbar RP, Bowen JD. The biceps squeeze test for diagnosis of distal biceps tendon ruptures. *Clin Orthop Relat Res* 2005; (437): 128–131.
- Dobbie RP. Avulsion of the distal biceps brachii tendon. *Am J Surg* 1941; 51: 662–683.
- Amin NH, Volpi A, Lynch TS, Patel RM, Cerynik DL, Schickendantz MS, Jones MH. Complications of Distal Biceps Tendon Repair: A Meta-analysis of Single-Incision Versus Double-Incision Surgical Technique. *Orthop J Sport Med* 2016; 4(10): 1–5.
- Schmidt CC, Brown BT, Schmidt DL, Smolinski MP, Kotsonis T, Faber KJ, Graham KS, Madonna TJ, Smolinski PJ, Miller MC. Clinical and functional impairment after nonoperative treatment of distal biceps ruptures. *J Shoulder Elb Surg [Internet]* 2019; 28(4): 757–764.
- Ahad A, Haque A, Armstrong A, Modi A, Pandey R, Singh HP. The management of displaced humeral shaft fractures – A survey of UK shoulder and elbow surgeons. *Shoulder Elb* 2021; 0(0): 1–6.
- Baldwin MJ, Nagra NS, Merritt N, Rees JL, Carr AJ, Rangan A, Thomas M, Beard DJ, Cooper C, Kottam L, et al. The use of a patch to augment rotator cuff surgery – A survey of UK shoulder and elbow surgeons. *PLoS One [Internet]* 2020; 15(4): 1–10.