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## **Outcome following acute suture anchor repair of the ulnar collateral ligament of the thumb**

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**Keywords:** Thumb; ulnar collateral ligament; suture anchor; patient-reported outcomes

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**Informed consent declaration:** Verbal informed consent was obtained from all subjects before the study. Written informed consent was not obtained because patient-reported outcomes were collected via telephone survey.

**Contributorship details:** WMO researched the literature, collected the data, performed the statistical analysis and wrote the manuscript. ZJP and KRB collected the data and assisted with manuscript preparation. SGM and ADD performed patient care and management and supervised the study. ADD conceived the study. All authors reviewed and edited the manuscript and approved the final version.

## ABSTRACT

**Background:** The aim of this study was to evaluate the outcomes following acute repair of the ulnar collateral ligament of the thumb metacarpophalangeal joint (thumb UCL) using a suture anchor technique.

**Methods:** From 2011-2019, we retrospectively identified 40 adult patients from a single centre that had undergone an acute thumb UCL repair ( $\leq 6$ wks post-injury). The mean age of the study cohort was 37yrs (range 16-70) and 68% (n=27/40) were male. The primary long-term outcome was the patient-reported QuickDASH score. Secondary outcomes included complications, the EuroQol 5-Dimension (EQ-5D)/Visual Analogue Scale (EQ-VAS) and return to work and sport.

**Results:** Postoperative complications included self-limiting sensory disturbance (7.5%, n=3/40), superficial infection (requiring oral antibiotics; 5%, n=2/40) and wound dehiscence (requiring surgical debridement and re-closure; 2.5%, n=1/40). There were 33 patients (83%) that completed the outcomes survey at a mean of 4.3yrs (range 1.0-9.2). The mean QuickDASH was 3.7 (range 0-27.3), EQ-5D 0.821 (range -0.041-1) and EQ-VAS 84 (range 60-100). No failures of repair were reported, and all patients were satisfied with their outcome (mean satisfaction score 9.8/10 [8-10]). Of the 32 employed patients, all returned to work at a median of 0.5wks (range 0-416) and the mean QuickDASH Work Module was 4.1 (range 0-50). Of the 24 patients playing sport prior to injury, 96% (n=23/24) returned at a median of 16wks (range 5-52) and the mean QuickDASH Sport Module was 4.6 (range 0-25).

**Conclusions:** Thumb UCL repair using a suture anchor technique is safe and effective up to six weeks post-injury. Pain and stiffness may persist in the longer-term, but most patients report excellent upper limb function and health-related quality of life. The majority return to work and sport and are highly satisfied with their outcome.

**Keywords:** Thumb; ulnar collateral ligament; suture anchor; patient-reported outcomes

**Level of Evidence:** III (retrospective cohort study)

## INTRODUCTION

Acute injuries to the ulnar collateral ligament of the thumb metacarpophalangeal joint (thumb UCL) comprise around 50 per 100,000 emergency department attendances.<sup>1</sup> Although thumb UCL sprains and partial tears may be successfully managed non-operatively,<sup>2,3</sup> non-operative management of complete thumb UCL tears yields inconsistent results<sup>4-7</sup> and there is a high rate of failure necessitating operative repair.<sup>3,8</sup> Surgical management is routinely recommended for complete unstable injuries to thumb UCL, in order to restore thumb stability and mitigate metacarpophalangeal joint arthritis.<sup>2,4,8,9</sup>

Various techniques exist for bony reattachment of the thumb UCL, including pullout suture,<sup>4,5</sup> tension-band wiring<sup>10</sup> and mini-hook plate fixation.<sup>11</sup> The use of suture anchors for thumb UCL repair was first documented thirty years ago,<sup>12</sup> and suture anchor repair has since increased in popularity due to its favourable biomechanical properties,<sup>13</sup> low complication rate<sup>9</sup> (particularly compared with pullout suture<sup>14</sup>) and the positive clinical outcomes associated with the technique.<sup>8</sup>

However, studies reporting outcomes following suture anchor repair are heterogeneous, involving a range of anatomical sites outwith the thumb,<sup>15</sup> a mix of acute and chronic injuries<sup>6,16,17</sup> and the use of supplementary transarticular K-wiring<sup>18</sup> or suture tape augmentation.<sup>19</sup> While several studies document functional outcomes based upon quantitative measures such as thumb range of motion and pinch grip strength,<sup>6,15,18,19</sup> few have used validated patient-reported outcome measures<sup>19,20</sup> and these involve specific groups such as college football players<sup>20</sup> or patients undergoing suture tape augmentation.<sup>19</sup> There are limited data regarding return to work and sport<sup>16,17,20-22</sup> following suture anchor repair, with the latter generally focusing upon athletic populations such as alpine skiers<sup>21</sup> or collegiate athletes.<sup>20,22</sup> To our knowledge, there are no

studies in the existing literature using patient-reported outcomes for an unselected cohort of active adult patients following simple suture anchor repair of the thumb UCL.

The aim of this study was to evaluate the complications and long-term patient-reported outcomes for a consecutive cohort of adult patients undergoing acute thumb UCL repair using a suture anchor technique.



## METHODS

### *Study cohort*

Patients were retrospectively identified from electronic records held at the study centre. All adult patients (aged  $\geq 16$  years) with a complete thumb UCL rupture undergoing acute (within six weeks of injury) suture anchor repair between January 2011 and December 2019 were included. Patients with additional thumb injuries (e.g. radial collateral ligament injury, metacarpal/phalangeal fracture) or chronic thumb UCL ruptures (beyond six weeks post-injury) were excluded. One patient was found to have a grossly lax but otherwise intact UCL intra-operatively and was therefore excluded. Four other patients underwent thumb UCL repair using another technique (direct suture repair,  $n=3$ ; K-wire fixation,  $n=1$ ). Forty patients met the criteria and formed the study cohort. The study was prospectively registered with the local musculoskeletal quality improvement committee and approved by the local orthopaedic research database (reference 16/SS/0026).

### *Patient and injury characteristics*

The mean age at injury was 37 years (range 16 to 70) and 68% ( $n=27/40$ ) were male (**Table 1**). Eight patients (20%) had documented medical comorbidities. The majority of thumb UCL ruptures (58%,  $n=23/40$ ) were sustained through a sporting mechanism. Sixty-eight percent of injuries ( $n=27/40$ ) were right-sided. The UCL was avulsed from the proximal phalanx in the majority of injuries (85%,  $n=34/40$ ). The remainder involved avulsions from the metacarpal head (13%,  $n=5/40$ ) or a mid-substance tear (3%,  $n=1/40$ ). Over half of injuries (58%,  $n=23/40$ ) involved an associated avulsion fracture, either from the proximal phalanx (53%,  $n=21/40$ ; **Figure 1A-1B**) or metacarpal head (5%,  $n=2/40$ ), with the remainder being purely ligamentous (**Figure**

**2A). Seven patients (18%) had a Stener lesion identified intra-operatively.** All except three injuries (93%) were isolated. One patient, who sustained their thumb UCL rupture while mountain-biking, suffered an ipsilateral grade I acromioclavicular joint injury. Another, who sustained their thumb UCL rupture during a simple fall, also suffered ipsilateral radial head and scaphoid fractures. Finally, one patient who sustained their thumb UCL rupture during an alleged assault also suffered a minor head injury.

### ***Initial management***

The diagnosis of thumb UCL rupture was based on clinical and/or radiographic findings. The absence of a firm end-point on valgus stress testing of the thumb metacarpophalangeal joint (MCPJ) in both extension and 30 degrees of flexion,<sup>6,23</sup> and/or a difference of greater than 30 degrees compared to the contralateral side,<sup>7</sup> were considered diagnostic of thumb UCL rupture. All patients were examined by one of the senior authors (both consultant orthopaedic surgeons) before being counselled and listed for surgery. Stress radiographs were obtained in cases of diagnostic uncertainty (**Figure 2B**). No patient underwent further imaging to confirm the diagnosis.

### ***Surgical details***

Over the nine-year study period, surgical procedures were performed under the care of five consultant orthopaedic surgeons. Three had Level 3 expertise (experienced) and two had Level 4 expertise (highly experienced). The mean interval from injury to surgery was 17 days (range 1 to 42). An examination under anaesthetic was performed prior to the procedure to confirm thumb MCPJ instability and the need for surgery. All procedures were performed under general

anaesthesia with an upper arm tourniquet in place. Intravenous antibiotics were administered prior to tourniquet inflation. A dorsoulnar approach to the thumb MCPJ was performed, through an oblique or 'lazy-S' incision. The dorsal sensory branch of the radial digital nerve was identified and protected. Dissection was performed down to the adductor pollicis aponeurosis, which was longitudinally incised to expose the dorsal capsule of the MCPJ. The MCPJ was then visualised through gentle abduction of the proximal phalanx and irrigated to remove any intra-articular bony fragments. The avulsed portion of the ulnar collateral ligament was defined and an appropriate location for UCL reattachment was identified and prepared as necessary. In all cases the UCL was repaired using a 1.8mm non-absorbable suture anchor (Depuy Mitek Inc, Raynham, MA). **The anchor hole was drilled under direct vision, ensuring this was in an appropriate extra-articular location before the suture anchor was inserted. The UCL was reattached onto the metacarpal head or proximal phalanx using a braided non-absorbable suture (e.g. Ethibond; Ethicon, Somerville, NJ). Where present and amenable to fixation, the avulsed bony fragment was incorporated into the repair.** In all cases the adductor pollicis aponeurosis was repaired. Following this, the thumb MCPJ was examined both in extension and 30 degrees of flexion to ensure joint stability. Transarticular K-wires were not used. The wounds were dressed following closure and the thumb immobilised in a plaster of Paris thumb spica cast.

### ***Postoperative management and rehabilitation***

All patients were reviewed in the outpatient clinic within 14 days for a wound inspection, reapplication of a lightweight resin thumb spica cast and further radiographs (**Figure 2C**). Patients were routinely immobilised in a cast for six weeks postoperatively. At this stage, most patients (90% n=36/40) were referred for a programme of specialist hand physiotherapy. Four patients

opted not to receive formal physiotherapy input. All patients were advised to avoid heavy lifting, impact activities and contact sports for three months postoperatively.

### ***Short-term outcomes***

Short-term outcomes were collected retrospectively and determined from outpatient records. Specific immediate post-operative complications were recorded, including sensory disturbance, infection, wound dehiscence, failure of repair and the need for further surgery.

### ***Long-term patient-reported outcomes***

Long-term follow-up was obtained via a telephone survey. Thirty-three patients (83%) completed the survey. Four patients had moved away from the region and had no valid contact details, and three patients failed to respond despite multiple attempts. Informed verbal consent was obtained from all participants completing the survey. Participants were specifically asked about further surgical procedures, and any other complications (including infection) that may have required additional treatment.

The primary long-term outcome measure was the abbreviated Disabilities of the Arm, Shoulder and Hand score (QuickDASH; 0 = no disability, 100 = complete disability),<sup>24</sup> which has been used previously to assess function following thumb UCL repair<sup>19,20</sup> and is suitable for verbal administration.<sup>25</sup> The QuickDASH questionnaire includes specific Sport and Work Modules which were also completed where appropriate. Health-related quality of life was assessed using the EuroQol Five-Dimension Three-Level Health Outcome score (EQ-5D; -0.59 = worst health, 1 = perfect health) and Visual Analogue Scale (EQ-VAS; 0 = worst health, 100 = perfect health).

Participants were asked to indicate their level of thumb pain on a four-point scale (none, mild, moderate, severe), along with whether they had any stiffness in their thumb and how much it affected them (0 = no limitation, 10 = severe limitation). Patients were also asked whether they had returned to their main sport and pre-injury employment postoperatively, and the time taken to do this (in weeks). Finally, they were asked to indicate their satisfaction with the outcome of their UCL repair, on a scale of 0 to 10 (0 = very dissatisfied, 10 = very satisfied).

### ***Statistical analysis***

Statistical analysis was performed using SPSS version 25.0. The relationship between time to surgery and the QuickDASH was assessed using simple linear regression. Significance was set at  $p < 0.05$ .

## RESULTS

### *Short-term outcomes (n=40)*

Outpatient follow-up was documented for all patients until a mean of 9.6 weeks (range 3.6 to 29.7). Postoperative complications included self-limiting sensory disturbance (7.5%, n=3/40), superficial infection (all resolved with oral antibiotics; 5%, n=2/40) and wound dehiscence (requiring surgical debridement and re-closure; 2.5%, n=1/40). One further patient had a suture sinus that healed with simple dressings but did not require antibiotics or other intervention. No early failures of UCL repair were observed.

### *Long-term patient-reported outcomes (n=33, 83%)*

At a mean of 4.3 years (range 1.0 to 9.2) postoperatively, no failures of UCL repair or additional surgical procedures were reported. The mean QuickDASH was 3.7 (range 0 to 27.3), EQ-5D was 0.821 (range -0.041 to 1) and EQ-VAS was 84 (range 60 to 100, **Table 2**). There was no relationship between time to surgery and the QuickDASH ( $p=0.310$ ).

Residual thumb pain was reported by 33% (n=11/33) but was rated as mild by 27% (n=9/33) and moderate by 6% (n=2/33). Ten patients (30%) reported some degree of thumb stiffness, which was generally mild and non-limiting (mean stiffness severity 1.3/10, range 0 to 6). All patients were satisfied with the outcome of their UCL repair, and the mean satisfaction score was 9.8/10 (range 8 to 10).

All patients who were in employment prior to their injury (100%, n=32/32) returned to work at a median of 0.5 weeks (range 0 to 416). The mean QuickDASH Work Module score was 4.1 (range 0 to 50). One patient, a bricklayer, reported being unable to return to work for eight years (416 weeks) after his UCL repair due to significant functional limitation (QuickDASH Work

Module score = 50). Of the 24 patients involved in sport prior to their injury, 96% (n=23/24) returned to sport at a median of 16 weeks (range 5 to 52). For the 23 patients playing sport at longer-term follow-up, the mean QuickDASH Sport Module score was 4.6 (range 0 to 25).

## DISCUSSION

In this large series of consecutive adult patients undergoing acute thumb UCL repair using a suture anchor technique, upper limb function and health-related quality of life were excellent at a mean of four years postoperatively. Although pain and stiffness were common, these symptoms were generally mild, and all patients were highly satisfied with their outcome. Return to activity was almost universal, with 100% returning to work and 96% returning to sport. Thumb UCL repair using a suture anchor technique, performed within six weeks of injury, is associated with a low rate of operative complications and good long-term patient-reported outcomes. As the largest series in the literature evaluating simple suture anchor repair outcomes for unselected active adult patients, we hope that our findings will inform surgeons and patients regarding the prognosis following surgery for an acute complete thumb UCL rupture.

The QuickDASH for our study cohort was superior to published values for age-matched populations in the United States<sup>26</sup> and Europe,<sup>27</sup> and the mean EQ-5D and EQ-VAS for the cohort were similar to published values in the uninjured population.<sup>28</sup> In the only other series documenting validated patient-reported outcomes following suture anchor repair, Werner *et al.* found an average QuickDASH of 1.0 at six years postoperatively in a cohort of 18 former collegiate football players,<sup>20</sup> while Lee *et al.* reported an average QuickDASH of 11.9 at 18 months postoperatively in a cohort of 13 adults who had also undergone suture tape augmentation.<sup>19</sup> Our results suggest that excellent long-term upper limb function can be achieved in an unselected cohort of adult patients following simple suture anchor repair. Moreover, given the lack of consensus regarding the optimal timing of thumb UCL repair surgery<sup>2,14,21,29</sup> this study may offer reassurance that long-term function can be restored following thumb UCL repair up to a relatively late stage following injury. Some have advocated that early surgery – within anything from two



days to four weeks of injury<sup>2,14,21,29</sup> – is indicated in order to achieve optimal outcomes following thumb UCL repair. This study provides good evidence that patient-reported outcomes following suture anchor repair were excellent when performed within six weeks of thumb UCL injury, and that there was no relationship between the time to surgery and functional outcome.

One-third of patients in the present study reported some degree of pain and stiffness, although this was generally mild and not functionally limiting. Residual thumb pain following suture anchor repair occurs in between 0% and 43% of patients,<sup>6,16–18,30</sup> but is generally reported to be mild in severity.<sup>6,21</sup> Similarly, stiffness following suture anchor repair is documented in 0% to 67% of patients.<sup>16–18,21</sup> At a mean of over two years following suture anchor repair, Katolik *et al.* observed that range of motion at the thumb metacarpophalangeal and interphalangeal joints were 97% of the contralateral side.<sup>14</sup> Although functional outcomes are generally excellent, patients should be counselled that mild pain and stiffness may persist in the longer-term.

It is uncertain whether residual thumb stiffness represents a complication of the suture anchor technique, or whether it is simply the result of the UCL injury itself and postoperative immobilisation. One biomechanical study suggested that the suture anchor construct may be sufficiently stable to negate the need for immobilisation following thumb UCL repair,<sup>13</sup> and another *in vivo* study surmised that reducing the length of postoperative immobilisation may be beneficial to longer-term thumb range of motion.<sup>14</sup> Suture tape augmentation has been suggested as a possible means of improving biomechanical strength of suture anchor repair,<sup>19,22</sup> and although less restrictive postoperative immobilisation may have the potential to reduce longer-term thumb stiffness, it is unclear whether this translates into significantly improved functional outcomes for patients.<sup>19</sup>

Return to activity is a key tenet of thumb UCL repair. We observed excellent rates of return to sport (96%) and work (100%) among our unselected cohort of active adult patients. Other studies report rates of return to sport from 33% to 100% following suture anchor repair,<sup>16,17,20–22</sup> while others report return to sport of 100% of Major League Baseballers<sup>31</sup> and 96% of National Football League players<sup>32</sup> following UCL repair using unspecified techniques. Notably, many studies specifically focus upon sporting cohorts,<sup>20–22,31,32</sup> whereas our results may be generalisable to a more typical active adult population. Return to work following suture anchor repair is less frequently documented, but reported rates fall between 50% and 96%.<sup>16,17,30</sup> Our findings compare favourably and suggest the vast majority of patients can expect to return to their employment following surgery.

The rate of self-limiting sensory disturbance observed in our study (7.5%) is comparable to other series documenting paraesthesia in 0% to 18% of patients following suture anchor repair.<sup>6,14–16,20–22</sup> The lower rate of postoperative paraesthesia is considered a principal advantage of suture anchor fixation over other UCL repair techniques such as the pullout suture.<sup>14</sup> Similarly, the published rate of postoperative infection is 0% to 7%,<sup>6,14,15,20,22</sup> which is comparable to our findings (5%). One patient in our cohort developed a postoperative wound dehiscence requiring debridement and re-closure, and another an uncomplicated suture sinus. Other series have observed a 7% rate of soft tissue complications following suture anchor repair.<sup>14</sup> Like almost all previous studies of the suture anchor technique,<sup>6,14,17,18,20,22</sup> we observed no failures of repair. Our results confirm that patients undergoing suture anchor repair within six weeks of injury are at a low risk of operative complications or failures of repair.

This retrospective study has limitations. As long-term outcomes were determined through review of medical records and a telephone survey, we were unable to undertake quantitative

measurements of thumb function (range of motion, key-pinch strength, stability testing etc). However, we would suggest that patient-reported function and health-related quality of life are potentially more useful indicators of treatment success. Similarly, we were not able to obtain long-term radiographic follow-up and it is uncertain whether some patients reporting pain and stiffness could have developed early MCPJ arthritis, although this has not been previously reported following acute thumb UCL repair.<sup>14</sup> Although patient-reported outcomes were satisfactory, we recognise there may be a ceiling effect in the QuickDASH. The presence of a comparator group, comprising non-operative management or another UCL repair technique, would have been useful in demonstrating the relative advantages and disadvantages of suture anchor repair.

In conclusion, at a mean of over four years postoperatively, acute thumb UCL repair using a suture anchor technique was associated with a low rate of complications and no failures of repair. Furthermore, the technique appears to be safe and effective up to six weeks post-injury. Among our cohort of unselected adult patients, the patient-reported upper limb function and health-related quality of life were excellent, and all were satisfied with the outcome of their surgery. Pain and stiffness were commonly reported but were generally mild and non-limiting. All patients returned to work and the vast majority returned to sporting activity.

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## TABLES

**Table 1:** Baseline patient and injury characteristics for the study cohort (n=40)

Gender (n, %)	Male	27, 67.5%
	Female	13, 32.5%
Age at injury (years)		
Mean $\pm$ SD (range)		37.0 $\pm$ 13.5 (16.1-70.1)
Comorbidities (n, %)	None	32, 80%
	$\geq 1$	8, 20%
Smoking status		
Non-smoker		30, 75%
Smoker		10, 25%
Alcohol intake		
Abstinent		4, 10%
Moderate		36, 90%
BMI (kg/m <sup>2</sup> )		
Mean $\pm$ SD (range)		25.9 $\pm$ 4.1 (18.3-38.3)
SIMD quintile (n, %)		
1 (most deprived)		5, 12.5%
2		7, 17.5%
3		4, 10%
4		8, 20%
5 (least deprived)		16, 40%
Injury mechanism (n, %)		
Fall from standing		11, 27.5%
Fall from height		1, 2.5%
Sport		23, 57.5%
Other		5, 12.5%
Side of injury (n, %)		
Right		27, 67.5%
Left		13, 32.5%
Side of injury (n, %)		
Dominant		24, 60%
Non-dominant		16, 40%
Injury type		
Pure ligamentous		17, 42.5%
Bony avulsion		23, 57.5%
Concomitant injury		
No		37, 92.5%
Yes		3, 7.5%

BMI, body mass index; CI, confidence interval; SD, standard deviation; SIMD, Scottish Index of Multiple Deprivation

**Table 2:** Patient-reported outcomes at  $\geq 1$  year following thumb UCL repair (n=33)

QuickDASH		
	Mean $\pm$ SD (range)	3.7 $\pm$ 6.0 (0-27.3)
EQ-5D		
	Mean $\pm$ SD (range)	0.821 $\pm$ 0.276 (-0.041-1)
EQ-VAS (0-100)		
	Mean $\pm$ SD (range)	84 $\pm$ 10 (60-100)
Thumb pain		
	None	22, 67%
	Mild	9, 27%
	Moderate	2, 6%
Pain score (0-100)		
	Mean $\pm$ SD (range)	88 $\pm$ 17 (40-100)
Stiffness		
	No	23, 70%
	Yes	10, 30%
Stiffness severity (0-10)		
	Mean $\pm$ SD (range)	1.3 $\pm$ 1.9 (0-6)
Satisfaction (0-10)		
	Mean $\pm$ SD (range)	9.8 $\pm$ 0.6 (8-10)

## FIGURES

**Figure 1A:** Anteroposterior and lateral radiographs of a 37 year-old female patient with an ulnar collateral ligament injury of the left thumb, sustained while playing football; note the avulsion fracture at the volar-ulnar aspect of the proximal phalanx.



**Figure 1B:** Anteroposterior and lateral radiographs following suture anchor repair; note the avulsion fragment has been incorporated into the repair.



**Figure 2A:** Anteroposterior and lateral radiographs of a 42 year-old female patient with an ulnar collateral ligament injury of the right thumb, sustained while skiing.



**Figure 2B:** Anteroposterior radiograph, taking during valgus stress, confirming thumb metacarpophalangeal joint instability.



**Figure 2C:** Anteroposterior and lateral radiographs following suture anchor repair.

