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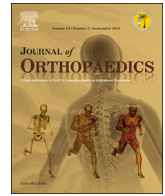
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# Rock climbing injuries and time to return to sport in the recreational climber

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## ABSTRACT

We investigated the injury pattern in rock climbers and their return to sport for operative and nonoperative management.

432 injuries in 237 climbers recorded: 41.9% hand/elbow, 19.9% foot/ankle, 17.3% shoulder. 66% patients required no treatment, 49 (21%) underwent physical therapy, 27 (11%) underwent surgery with 93% satisfaction. Nonoperative patients recovered at 3.9 months; surgical patients took 9.1 months to return to sport ( $p = 0.01$ ). Return to same level: 79% nonsurgical patients and 70% surgical patients ( $p = 0.30$ ).

Most injuries underwent nonoperative treatment. Operative treatment allowed a similar amount to return to sport at pre-injury level with a longer time course.

## 1. Introduction

Rock climbing is becoming an increasingly popular sport with the rise in focus by media attention, access to indoor climbing facilities and recognition as an Olympic sport by the International Olympic Committee in 2020.<sup>1,2</sup> However, unlike many developed sports, rock climbing has not undergone significant study.

There have been a few studies investigating injury patterns in European rock climbers, however many are evaluating the elite athlete and without commenting on average time to return to sport.<sup>3–6</sup>

The authors sought to determine: (1) What is the prevalence of rock climbing injury in recreational climbers?, (2) What type of injuries were sustained?, (3) How many required surgery?, (4) How long did the recovery process take in climbers who underwent operative versus conservative treatment?

## 2. Methods

This was a cross sectional study, based on the completion of an anonymous questionnaire, and was approved by the University of California: Davis Research Ethics Institutional Review Board. Institutional research support received from Zimmer Biomet and Depuy. Each author certifies that their institution approved or waived approval for the use of human subjects for this investigation and that all investigations were conducted in conformity with ethical principles of research.

Between 2017 and 2018, rock climbers on rock climbing forums and at local gyms around Sacramento, CA were queried utilizing an online questionnaire form. Patient demographics were obtained by asking their age category, sex, climbing experience and level of climbing (years climbed and Yosemite Decimal System and Hueco Tanks Bouldering Grade). Types of injuries were categorized into hand & elbow, shoulder, spine, pelvis/hip, knee, foot & ankle and other. We asked climbers to mark any anatomical area that was injured requiring a cessation of climbing. We asked if any surgery or therapy was performed, what type of surgery was performed, and if they were satisfied or dissatisfied. We then asked how many months did the recovery process take to climb at your pre-injury grade or better? We considered this a full return to sport as opposed to a partial return.

Analysis of injury patterns, recovery time to full return to sport, nonoperative and operative surgical treatment, and which surgeries resulted in a failure to return to sport. Non-parametric data was evaluated using Chi-squared test.

## 3. Results

Of the 237 patients, 89.03% of the patients were aged between 19 and 35 years with 47.68% between 19 and 26 and 41.35% between 27 and 35 years. The average age of the climbers were 27.4 years. The surgical cohort was older at 29 years compared with the nonoperative group 27.2 years (Table 1). 196 (82.70%) were male and 41 (17.30%) were female. Average years of climbing experience was 4.3 years (range

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**Table 1**  
Preoperative data and analysis. YDS: Yosemite decimal system.

	Total	Nonoperative	Operative
N (climbers)	237	210	27
Age (years)	27.4	27.2	29.1
Sex	83% male, 17% female	83% male, 17% female	78% male, 22% female
Climbing Experience (years)	4.3	5.5	4.1
Climbing Grade (YDS)	5.11b	5.11b	5.11b
Bouldering Grade (Hueco)	V4-V5	V4-V5	V5

**Table 2**  
Types of climbing injuries and treatments in our cohort.

	Total	Nonoperative	P	Operative
N	432	378		54
Hand & Elbow	181 (41.9%)	168 (44.4%)		13 (28.1%)
Foot & Ankle	86 (19.9%)	69 (18.3%)		17 (31.5%)
Shoulder	75 (17.3%)	64 (16.9%)		11 (20.3%)
Knee	32 (7.4%)	27 (7.1%)		5 (9.3%)
Spine	16 (3.7%)	12 (3.1%)		4 (7.4%)
Hip	12 (2.8%)	11 (2.9%)		1 (1.9%)
Other	30 (6.9%)	27 (7.1%)		3 (5.5%)

0–15 years), with 20% under 1 year, 37% at 1–3 years, 14% at 3–5 years, 16% at 5–8 years and 8.5% at 9–15 years. The group climbed on average YDS 5.11b and bouldered between Hueco grades V4-5.

Patients recorded multiple injuries, totaling 432 injuries in 237 patients. In order of decreasing injury type there were 181 (41.9%) hand & elbow, (19.9%) foot & ankle, 75 (17.3%) shoulder, 32 (7.4%) knee, 16 (3.7%) spine, 12 (2.8%) hip, and 30 (6.9%) other (Table 2). Nonoperative patients elicited a similar injury distribution at 168 (44.4%) hand & elbow, 69 (18.3%) foot & ankle, 64 (16.9%) shoulder, 28 (7.1%) knee, 12 (3.1%) spine, 11 (2.9%) hip and 27 (7.1%) other injuries. The operative group had more foot & ankle injuries than hand & elbow. Their injuries listed consisted of 17 (31.5%) foot & ankle, 13 (28.1%) hand & elbow, 11 (20.3%) shoulder, 4 (9.3%) knee, 4 (7.4%) spine, 1 (1.9%) hip and 3 (5.5%) other.

154 (66%) patients underwent no treatment, 49 (21%) underwent formal physical or occupational therapy, 26 (11%) underwent surgery. Of those who underwent surgery, 24/26 (92%) were satisfied. Recovery back to pre-injury level took on average 4.4 months (range 0–5 years). Nonoperative patients recovered on average of 3.9 months, while surgical patients took 9.1 months on average to return to their pre-injury level (Table 3). While 8/27 (30%) surgical patients were considered to still recovering and thus not at their pre-injury level, 5/210 (2%) of nonoperative patients were considered to have never recovered and 38/210 (18%) were considered to be still recovering. Return to same level or better occurred in 80% of nonsurgical patients and 70% of surgical patients and (p = 0.30).

Surgical intervention for the 27 patients was primary for lower extremity injuries including 3 knee (patellar tendon, meniscectomy, ACL), 15 foot & ankle (8 ORIF, 1 osteochondral defect, ankle debridement, 1 peroneal retinaculum repair, 2 achilles repair, tibial nail, complex laceration), 4 shoulder (2 bankart, 2 clavicle ORIF), 2 hand & elbow (distal biceps repair, 1 SLIL repair), and 2 spine (instrumented

**Table 3**  
Return to sport in the operative and nonoperative groups.

	Total	Nonoperative	P	Operative
Time to return to sport (months)	4.4	3.85	0.0143	9.1
Percent who returned	78%	79%	0.302	70%

fusion for fracture). The majority of surgery involved the lower extremity.

Further investigation was performed into the patients that were unable to return to sport, which was 51 of 237 patients (22%). Of these 51 patients, 9 underwent surgery. The 8 surgical patients included 1 hand surgery for SLIL repair, 1 spinal fusion surgery for fracture from a fall, 2 shoulder & elbow surgeries including a bankart repair and distal biceps repair, 1 knee patellar tendon repair for rupture, and 3 foot & ankle surgeries involving primarily ankle arthroscopy and debridement for osteochondral defect and post traumatic arthritis of the talar body.

**4. Discussion**

The most commonly injured body parts sustained in rock climbing were the hand, wrist, shoulder, foot and ankle. Our data appears to be consistent with other reports of climbing injuries.<sup>3–6</sup> Backe et al. reported on 355 Swedish climbers, of which 106 (30%) reported an injury.<sup>3</sup> 93% of their injuries were overuse and involved the upper extremity, while 7% were traumatic and involved the lower extremity. Schoffl et al. reported on 911 climbing injuries in a popular climbing area in Germany.<sup>7</sup> Their results echoed Backe's work with hand overuse injuries being the most common at 52%, with pulley injuries being more likely encountered. Our report of upper extremity injuries being very common confirms previous studies. Foot and ankle injuries were next most common. One difference between our study and the others are the higher etiology of foot & ankle injuries. This may be due to a selection bias as the other studies were based upon their clinic volume, which may not treat lower extremity or foot & ankle injuries. Additionally, many of the authors have specialized expertise in upper extremity injuries thus potentially selecting for these injuries.

A majority of these injuries (89%) were amenable to nonoperative treatment or formal physiotherapy. Initial conservative therapy is common for overuse injuries and even mild/moderate traumatic injuries such as an ankle sprain, isolated pulley rupture or nondisplaced fractures and appears to be consistent with other studies.<sup>8–10</sup> Schoffl et al.<sup>8–10</sup> reported on 21 rock climbers who sustained finger pulley ruptures of varying severity. All were treated conservatively, and all had returned to climbing within a year with an excellent outcome (Buck-Gramcko score 3).<sup>10</sup> Schneeberger et al.<sup>11</sup> reported on 43 climbers who sustained pulley ruptures treated with a conservative splint. 38 patients were able to return to their previous level of climbing on average 8.8 months. 39 assessed their injury as good, with 4 as very good. Maitland et al. reported on 148 patients who sustained injuries rock climbing in Canada.<sup>12</sup> While the vast majority were overuse injuries involving the upper extremity, 18% of them were traumatic falls involving the lower limbs, and only 2% of all the injuries were disabling enough to prevent ambulation. It appears that many overuse climbing injuries can be initially treated conservatively, while traumatic lower limb injuries from falls may require surgery, speaking to the severity of the injury.

Our study also reported 11% of patients undergoing surgery. A majority of the surgical indications were for lower extremity injuries, specifically to the foot and ankle. Many of them were attributed to a fall. This appears to be different than other reported studies that indicated overuse and upper extremity injuries were more common.<sup>6–11</sup> This may be due to the difference in recreational climbers versus elite climbers in those studies. It also may speak to the severity of falls compared to overuse and upper extremity ligament/tendon injuries. Schoffl et al.<sup>7</sup> reported on 911 climbing injuries between 2009 and 2012 in a popular German climbing area. More than 90% were upper extremity and treated conservatively, which may also speak to the selection bias they may have received. Only 1.6% were considered major injuries such as fractures in their study. Jones et al.<sup>13</sup> reported on 201 climbers sustaining 275 injuries in the United Kingdom. While upper extremity injuries were the result of overuse and strenuous activity, 10% of the injuries were from falls with lower limbs being the most

involved. This may suggest lower extremity injuries are infrequent, serious injuries that may more often require surgery and may have a prolonged recovery. Additionally, in our cohort, half of the surgical patients who were unable to return to sport were knee and below injuries.

We reported that our recovery time was 3.9 months in the non-operative group and 9.1 months in the operative group, although surgical timing and the number of patients able to return to sport at their pre-injury level (79% vs 70%,  $p = 0.30$ ) was no different. Schneeberger et al.<sup>11</sup> took 8.8 months pulley injury. Schoffl et al. reported on pulley injuries managed conservatively that took 1 year to return to sport.<sup>10</sup> Bouyer et al.<sup>14</sup> reported results of pulley reconstruction using extensor retinaculum graft in 38 patients with 30 (79%) able to return to their previous climbing level by 6.4 months. Simon et al.<sup>15</sup> reported on 12 climbers who underwent rotator cuff repair. While their Constant-Murley score improved to 92 points, only 42% were able to return to their previous level of climbing at 1 year. This low return to sport may be injury specific as a recent meta analysis reported less than 50% of professional athletes return to their same level of sport in golf, tennis or baseball.<sup>16</sup> Our study and others may suggest a time frame for setting goals and expectations to return to sport and whether or not at the same level.

There are a few limitations to this study. Self-report designs are subject to potential self-diagnosis. Responses were subjective and injuries were not always diagnosed by a medical practitioner. To mediate this problem, injuries were objectively categorized by anatomical location and mechanism. Recall bias was possible, leading to under-reporting of minor injuries and comparative over representation of more portion of medically treated and time-loss injuries. However, given that the largest proportion of injuries in this study were non-acute overuse injuries, the effect of recall bias is unclear. Additionally, our average level of climbing experience and skill was lower than the other reported studies in the literature.<sup>6–12</sup> This may suggest that higher level and sustaining injuries may occur more often in climbers who have been involved in the sport longer. This also may suggest novice climbers may have a higher chance of recovering or that the degree of injury may not be as severe.

Many of the climbing injury papers originate from Europe and Canada. This is one of the first papers documenting American climbing injuries. While they were similar in regards to type of injuries in the current literature, it suggested that lower limb injuries were the still prevalent and possibly more severe than upper limb injuries. While other papers looked specifically at return to sport for specific injuries, we looked at all injuries and compared return to sport in nonoperative and operative climbers. We believe this is the first paper to compare the two cohorts and suggests an optimistic outcome to the severity of injuries requiring surgery. Our outcomes may help guide the surgeon in patient expectations for timing and likelihood to return to climbing level.

## 5. Conclusion

Climbing injuries most commonly involve the hand & wrist, shoulder & elbow, and foot & ankle in decreasing order. While a majority of injuries can be treated nonoperatively, 11% of patients required surgery. Lower extremity injuries required more surgery more often, likely due to the severity of the injury. Nonoperative care allowed earlier return to sport, yet there was no difference in return nor return at the same level or better between conservative and surgical care.

### 5.1. What is already known on this topic

- Rock climbing injuries tend to be comprised of two types: overuse/strenuous injuries and traumatic
- Overuse injuries most commonly involve the upper extremity such as hand, wrist, elbow and shoulder
- The majority of overuse injuries can be treated conservatively

### 5.2. What this study adds

- Lower extremity injuries from falls or ligament/tendon involvement is a frequent injury pattern in rock climbing
- Although most self-reported climbing injuries may undergo conservative care, up to 10% of these injuries may undergo surgery
- While conservative care allowed a 3.9 month return to sport compared to surgical intervention at 9.1 months, both had a similar number of climbers able to return to climbing.

## Disclosures

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