



## **IFSSH Scientific Committee on Sports Injuries in the Hand**

**Chair: Loris Pegoli (Italy)**

**Committee: Gregory Bain (Australia)**  
**Alejandro Badia (USA)**  
**Riccardo Luchetti (Italy)**  
**Moroe Beppu (Japan)**

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## HAND INJURY IN ROCK CLIMBING

Rock climbing has become very popular during the last decades, seeing a constant continuous growth of people practicing this sport. The higher the number of participants, the higher the number of injuries related to this sporting practice. Many hand surgeons in the last ten years have been exposed to rock climbing injuries.

Due to the specific functional needs that rock climbers require to practice this activity, higher standards of treatment are required to treat specific rock climbing-related injuries. The aim of this report is to produce a literature review of the rock-climbing related articles published in the last decade.

The NCBI database was searched through the following website: <http://www.ncbi.nlm.nih.gov/pubmed> on August 12th 2014. The keywords used in the search were the following: "*rock climbing*", "*rock climbing injuries*", "*rock climbing hand*", "*rock climbing hand injuries*". The results are shown in Table 1.

<b>Keyword used</b>	<b>Number of results</b>
Rock climbing	216
Rock climbing injuries	98
Rock climbing hand	71
Rock climbing hand injuries	39

*Table 1: Results of the NCBI database research.*

Any article published before 2004 was not included in this literature review that aims to consider only what has been published in the last decade. 143 original articles were found in this way. Only articles in English were considered.

Of these articles, 113 were not considered for the review because, even if directly related to rock climbing, they were not dealing with rock climbing injuries or rock-climbing related trauma. The topics of those not included were related to the description of surgical techniques regarding sport or rock-climbing injuries, imaging, psychological evaluation of professional athletes, training methods, biomechanical evaluation of different grips, physiological response of the human body to prolonged muscular stress and anthropometrical studies on climbers.

Of the remaining 30 original articles published in the last ten years on rock-climbing related injuries, nearly half were not focused on a specific anatomical region. More than

one quarter were focused on hand and wrist injury in particular. Other articles described conditions regarding feet, shoulder and spine injuries as well as other body parts. The results are reported in Table 2. Only articles related to the whole body or to hand and wrist injury were considered for further analysis<sup>(1-22)</sup>.

<b>Area of interest</b>	<b>Number of results</b>
General	14 (46.6%)
Hand and wrist injuries	8 (26.6%)
Foot injuries	2 (6.7%)
Shoulder injuries	2 (6.7%)
Others (spine, knee and hip)	4 (13.4%)

*Table 2: Distribution of rock-climbing related injuries articles published in the last ten years.*

There are two main categories of rock climbing: traditional and alpine climbing in which few protections are used and the sport is practiced in a high-risk environment; and sport or recreational climbing where more protections are used, and the sport is practiced in a low-risk environment. This latter category includes bouldering, sport climbing and indoor climbing. Of the 22 articles analyzed<sup>(1-22)</sup>, 14 (63.6%) addressed a specific attention to the environment where the climbing-related injury occurred. In eight studies (36.4%) only recreational and sport climbing activities were considered. Six studies (27.2%) were focused on alpine and traditional sport-climbing. In the remainder, the particular kind of climbing related activity was not defined.

<b>Climbing activity</b>	<b>Number of results</b>
No distinction	8 (36.4%)
Recreational and sport climbing	8 (36.4%)
Alpine and traditional climbing	6 (27.2%)

*Table 3: Distribution of rock-climbing related injuries articles published in the last ten years, classified according to the kind of activity studied.*

This distinction is important in defining the number, the severity and the kind of rock-climbing related injuries.

A further difference is apparent when considering the injury rates per hours of activity. The literature reports a number of injuries per 1000 hours that ranges from 0.079 to 0.2 every 1000 hours in indoor climbing and from 0.6 to 4.2 every 1000 hours for outdoor climbing.

These differences between sport and traditional climbing receive poor attention in the literature in relation to the prevalence of injuries among climbers. The data are often not comparable since most of the studies are based on surveys and the population examined in each single study differs a lot in terms of dimension, climbing experience, hours of training and preferred activity (bouldering, sport or traditional climbing). From our analysis it can be assumed that the prevalence of injury varies from 20% in an heterogenic climbing population to 80% among experienced climbers. The higher incidence of injuries in semi and professional athletes is proportionally related to the amount of hours spent in training. These prevalences include any kind of injury reported to the authors. Most of the injuries were generally minor, with 81% (range 74.4% - 93%) of injuries reported in the main as minor injuries.

Rock climbing-related injuries can also be classified on the basis of the cause. The most common cause of injury reported in the literature for outdoor climbing is a fall, while in indoor and sport climbing overuse is the main cause.

The anatomical areas that are most involved in rock climbing injuries vary for a fall related injury and an overuse injury. In the majority of the studies the incidence of accident related to a specific anatomical part was not documented, either because the study was focused on hand and wrist injuries or because this particular data was not present at all (Table 4).

<b>Climbing activity</b>	<b>Number of articles</b>	<b>Highest incidence</b>
Recreational and sport climbing	2 (9.1%)	No difference
	4 (18.2%)	Upper limb
	1 (4.6%)	Lower limb
Alpine and traditional climbing	1(4.6%)	Upper limb
	4(18.2%)	Lower limb
N/A	10 (45.5%)	N /A

*Table 4: Difference between the distribution of injuries for sport and traditional climbing. For sport, only one study reported a low incidence of injuries affecting the lower limb; two studies reported no difference between lower and upper limb. In alpine climbing, on the contrary, the highest incidence is found in the lower limb. Only one study found that there was a higher incidence for the upper limb. This study considered only the injuries occurring during ascending.*

Even if there are some exceptions, there is a general consensus that most injuries that are associated with alpine climbing are related to a direct fall, belay accidents, falling rocks and others environment related factors, so the percentage of injuries that affect the lower limb is higher. During sport and indoor climbing most of the injuries reported

are due to overuse and in this case the upper limb and the hand, in particular, is definitely the most affected part.

From the analysis of the literature published on rock-climbing injuries in the last ten years, it can be concluded that the hand is the anatomy most commonly affected in overuse lesions that occur during sport or indoor climbing and bouldering.

<b>Kind of Injury</b>	<b>Number of results</b>
Flexor pulley lesions	44.3% (33-63)
Fractures	18.6% (12-29)
Strains and ligament lacerations	18.1% (17-19)
Wounds	13% (9-17)
Dislocations	8.5% (4.3-13)
Other disorders	

*Table 5: Climbing related hand injury average rates reported in literature*

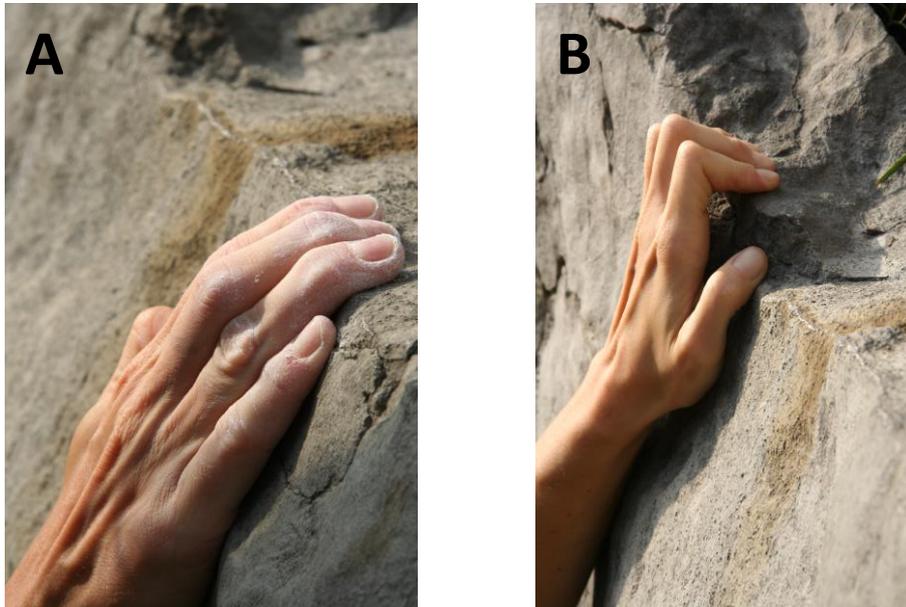
Lesions of the pulley mechanism is the most common lesion among climbers, followed by ligament strains and finger and metacarpal fractures. The incidence of the latter vary a lot according to the kind of activity examined and on the kind of injury studied (overuse or fall). Wounds and dislocations are also quite common hand accidents. Other disorders such as contusions, wrist ligament disorders, tendonitis and tendon ruptures are reported in some of the studies analysed (Table 5).

The explanation for the high incidence of flexor pulley lesion in rock climbers lies in the high mechanical weight load that the pulleys bear when climbers pull on their grips.

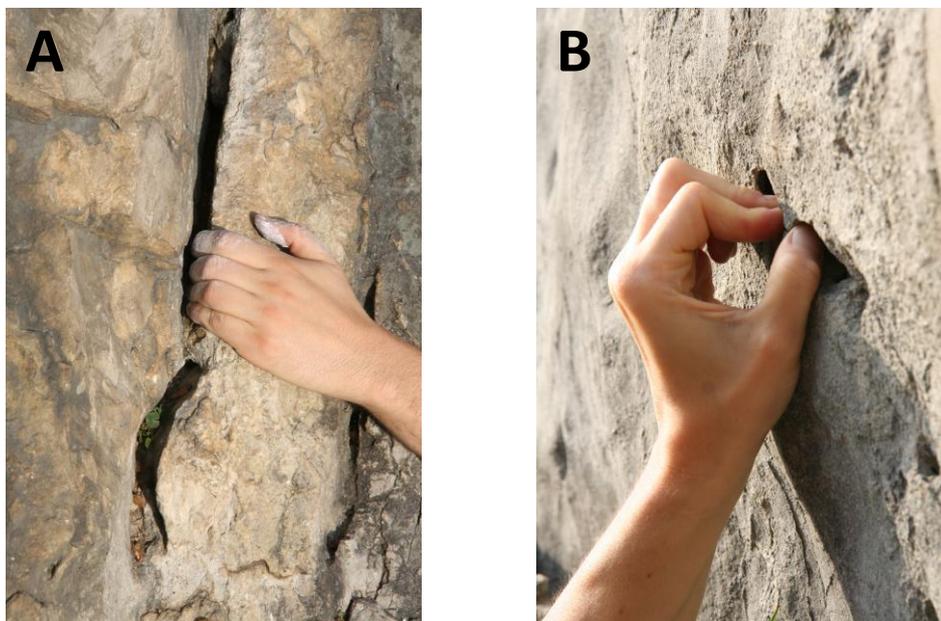
There are different kinds of grip in rock climbing that can lead to a flexor pulley lesion, Figure 1 shows two of the most common grips that climbers use. In one case both the proximal and distal interphalangeal joint are flexed and the weight is equally distributed among all the pulleys, whereas in the second case the distal interphalangeal joint is extended and the proximal interphalangeal joint is flexed more than 90 degrees. In this case the load is concentrated on the A2 pulley that has to bear the full load by itself. This position, called *full crimp grip*, is commonly used by climbers and is responsible for overload lesions of the flexor pulley system.

Another reason for pulley lesions and ligament strains in rock climbing are related to the special grips used to progress into cracks and holes (Figure 2). In this case, torsion of

the fingers is required to allow a secure and safe grip, with the drawback of an overload of the pulley mechanism and the ligament apparatus.



*Figure 1: (A) In this grip both the DIP and the PIP are flexed and the load is equally distributed, but there are cases in rock climbing where the so called “full crimp grip” (B) is necessary; in this case the DIP is extended and the PIP is flexed, and the pulley system is overloaded.*



*Figure 2: (A) Cracks usually oblige the climber to distort fingers in order to obtain a safe hold and do not allow finger mobility, leading to an higher ratio of pulley and ligament lesions. (B) Holes force fingers in the same way of cracks, stressing pulleys and ligaments in the same way.*

Since rock climbing has become so important in the modern landscape of sport activities it is very useful for the hand surgeon to know which are the most common pathologies expected in this particular group of athletes.

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