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Current Concepts Review

Return to sports following distal biceps tendon repair: A current concepts review

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ABSTRACT

Distal biceps tendon ruptures are relatively rare injuries but tend to occur in active and athletic populations, especially in weightlifting and contact sports. The distal biceps tendon is an important supinator of the forearm and flexor of the elbow, thus an injury to this ligament can be invalidating for athletes. The aim of this review was to determine the ability and the time to return to sports following distal biceps tendon repair in athletes and the level of performance. The literature is scarce about the return to sports among athletes. Most studies include athletes are National Football League (NFL) players, others are weightlifters and a few recreational athletes. The return to play rate after distal biceps tendon repair is high. The performances of the returned players were similar to matched players and most players returned to the same level. Most players—depending on the sport—were not able to return to competition within the same season. In order to manage expectations, it should be discussed preoperatively with the athlete (and their coach) that the return to sports rate is high, but the return will probably be the following season.

Current concepts

- Distal biceps tendon repair has good clinical functional outcomes and the return to work rate is high. Following distal biceps repair, 95% of the athletes tendon return to sports and 82% to the same preinjury level of competition. Functional outcomes following surgery are good and generally not clinically different compared to matched athletes. The time to return to sports is rather long, about 40 weeks in the current literature, depending on the type of sport.

Future perspectives

- The current literature on return to sports following distal biceps injuries and repairs is sparse. Future research is necessary to compare surgical techniques, rehabilitation programs (such as early mobilization), and functional outcomes in order to draw conclusions about factors on return to sports.

Introduction

Distal biceps tendon injuries occur at a rate of 0.9–2.55 per 100.000 patients [1]. In the general population, tears are most encountered in active middle-aged men. The dominant extremity is involved in 86% of the cases in the general population [2]. A heavy load on a flexed and supinated forearm can lead to a distal biceps tendon rupture [3,4]. Known risk factors for a distal biceps tendon injury in general, are smoking and steroid abuse [2]. High risk sports for distal biceps tendon ruptures are sports such as: weightlifting, American football, judo and other contact sports [5].

The distal biceps tendon is important for flexion and supination of the forearm [6,7]. Surgical repair has proven to be superior to non-operative treatment to regain supination and flexion strength [8]. There are different surgical approaches and refixation techniques. A one- or two-incision approach, as well as an endoscopic approach can be used. Multiple fixation techniques have been developed, which include cortical buttons, interference screws, bone transosseous suture repair technique and suture anchors [9–11]. Various comparative studies were performed across the range of techniques and approaches and appeared to be equivalent regarding functional outcomes and complication rates [12–17].

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Direct adequate postoperative management is important for the protection of the reconstructed tendon. Safe and effective rehabilitation following distal biceps tendon repair is accomplished through a stepwise program, gradually increasing the load on the repair site, while avoiding premature stress to the healing soft tissue [18]. A return to sports requires an adequate range of motion of the elbow, little pain, sufficient muscular strength and muscular endurance. To date there is no standardized postoperative protocol for optimal recovery following a distal biceps repair.

Recently, a systematic review was published about the return-to-work aspect [19]. The return to work rate was high, 89% fully returned to work within 3–4 months. A current review of the return to sports was lacking. The aim of this study was to conduct a review of the available literature to assess the athlete's ability to return to sports following distal biceps tendon repair and the average time taken to return to sports. The current available studies are summarized in Table 1. The majority of the athletes are able to return to same level of sports after distal biceps tendon repair, but the rehabilitation period is long.

Surgical repair

Approach and fixation techniques

The fixation technique and surgical approach might be important for return to play. As stated prior, there is a slight different in functional outcome (supination). There is no consensus if this is a factor for the return to play. Surgical repair restores biceps function, with an emphasis on restoration of supination in the forearm. To accomplish this, the biceps tendon is reattached at its anatomical position on the radial tuberosity [22]. Traditionally, two main approaches are being used: the single-incision technique and the double-incision technique. The single-incision technique is technically less demanding but does not allow for exact anatomic reattachment of the tendon [7]. Despite of this, the single-incision technique has rather good results using different fixation methods such as suture anchors, interference screws and buttons [23–25]. A disadvantage of this method is the deep dissection in the antecubital fossa, where the neurovascular structures near the tuberosity can be compromised. Therefore, the double-incision technique was developed by Boyd and Anderson to minimize the risk to neurovascular structures in the antecubital fossa [26]. The double-incision technique adds a posterior incision allowing for anatomic footprint repair, posterior to the protuberance. Although decisive evidence of superiority in clinical outcome is lacking, there is proof of slight better flexion and supination strength when anatomic repair was achieved [27,28]. Different fixation methods have been compared in biomechanical studies [26]. The Endobutton technique appears to have a greater pull-out strength compared to bone tunnels, suture anchors and interference screws in complete ruptures [29,30].

Rehabilitation protocol

The rehabilitation protocol was reported in only two studies. D'Alessandro et al. used a splint with the elbow in 90° of flexion and the forearm in supination for 3 weeks [20]. Active range of motion is then begun, followed by a progressive resisted strengthening program beginning 6 weeks postoperatively. Gowd et al. splinted the operated arm in 60° of flexion in neutral rotation for 2 weeks, followed by a removable extension blocking splint at 45°. Active and passive range of motion was advanced from 6 to 9 weeks with isometric exercises. The following 12 weeks, strengthening and sports-specific exercises were advanced as tolerated [6].

Functional outcomes

There was a considerable variation between studies in how functional outcome scores were documented. Postoperative range of motion (ROM) was not mentioned in the included studies. Isokinetic muscle testing was postoperatively performed by D'Alessandro et al. [20] The repaired

Table 1
Patient demographics of included studies

First author	Sport	Number patients, n	No. of male patients, n (%)	Mean age, yr	Follow-up, mo	Mean time injury – surgery, d	Dominant arm injuries n (%)	Time return to sports, mo	Return to sports rate, n (%)	Return to same level, n (%)
D'Alessandro, 1993 [20]	Weightlifting, Bodybuilding	10	10 (100%)	39.8 ± 2.4	49.5 ± 8.9	12.6 ± 4.5	6 (60%)	–	10 (100%)	–
Gowd, 2021 [6]	Athletic population	77	77 (100%)	47.5 ± 5.1	38.7 ± 6.7	70.8 ± 131.8	25 (41%)	6.0 ± 2.8	57 (93.4%)	40 (65.6%)
McGinnis, 2020 [3]	American Football	35	35 (100%)	28.5 ± 3.5	–	–	–	10.8 ± 3.7	33 (95%)	33 (94%)
Pagai, 2020 [21]	American Football	22	22 (100%)	28 ± 3.0	–	–	–	10.7 ± 1.5	21 (84%)	21 (84%)

N, number; Yr, year; mo, months; d, days.

dominant extremities had complete functional recovery, with the exception of a 20% loss of flexion endurance (30 repetitions). The group with a repaired non-dominant extremity showed 25% supination and 5% flexion maximum strength deficits (average of 3 maximum repetitions). Two of the three patients in the nondominant group had a supination deficit of 56% and 58%, but both participated in a sport that required mostly the dominant arm (respectively acrobatics and racquetball) [20]. Gowd et al. obtained the patient reported weight of the preoperative and postoperative 1 RM and 10 RM biceps curls and did not find statistically significant differences between preoperative and postoperative strength (1 RM: $p = 0.757$; 10 RM $p = 0.950$) [6]. McGinnis calculated presurgical and postsurgical performance scores for all patients by position, including matched controls. There was no statistically significant difference in their performance. However, after subgroup analysis, a statistically significant lower performance score for the defensive tackle (n = 5) was found ($p = 0.02$) [3]. Pagani et al. also calculated postoperative performance scores with matched controls and also found no difference in performance scores. They did find that the career length was statistically significant shorter for post injured defensive backs (n = 5) compared with controls ($p = 0.02$) [21].

Return to sports

The determination of when an athlete may return to sports can be difficult, and there are many issues involved. First, tendon fixation should be stable, and the tendon has been incorporated. In rotator cuff repair, bone-to-bone healing of autograft usually occurs by 6–12 weeks, after 6 months the tendon is healed to the bone [31]. Secondly, there are several factors involved for an athlete to return to sports. Griffith et al. identified several factors in return to sports after upper extremity surgery: time, muscle strength, range of motion, pain, successful sport specific testing, proprioception, patient-surgeon agreement on RTS clearance, radiographic healing. Third, the readiness for an athlete to be able to return to competition is dependent on type of sport and position in the game. However, there is to date no consensus on the return to sports criteria to use in clinical practice [32]. In the study of Gowd et al., 4 different fixation techniques and 2 different approaches were used and compared *(Table 2)*. They state that an increased duration to return to sports was associated with the single-incision approach in comparison to the double-incision (OR 5.209, 95% CI 1.239–20.903) ($p = 0.028$), dominant-side surgery (OR 6.370, 95% CI 1.639–24.762) ($p = 0.03$) and a suture anchor technique (OR 0.602, 95% CI 0.427–0.850) ($p = 0.006$) [6].

Return to sports rate

The overall return to sports rate is high among all studies. The length of a competition season has influence on time to return to play. The study of D'Alessandro was done in 10 athletes, of which 8 were weightlifters, with an average age of 49.5 ± 2.4 years [20]. The mean time to surgery was 12.6 ± 4.5 days and the follow-up time 49.5 ± 8.9 months. All athletes returned to sports, but the level of performance was not defined. The repair restored the function in all athletes adequately to be able to return to sports, also in weightlifters and bodybuilders with high strength demands. Gowd et al. showed the quickest and a relatively high return to sports rate among athletes from different sports at diverse levels were included in their study. Preinjury level was phrased as the level of activity occurring within 3 years of injury, the postinjury level was re-evaluated by identifying the ability to return to preinjury sporting activity at a 2-year follow-up, sporting details were not collected. In total 57 of the included 61 athletes (93.4%) returned to sports within a mean time of 6.0 ± 2.8 months. Forty athletes (65.6%) returned to the same level [6].

Two studies in American football players showed a similar rate of players return to sport, but in a longer time span [3,21]. In the study of McGinnis, 33 of the 35 players (94%) were able to return to sports and all 33 players returned to the same level [3]. The two players that did not return were both offensive linemen and further along in their career (9 and 14 years). The reason for not returning were not mentioned. Performance scores of the players that returned were similar to matched controls ($p > 0.05$), matched for position, age, experience, and performance statistics [3]. The study of Pagani et al. reported that the performance scores following repair were also similar with matched controls (matched for age, career experience, games per season, performance scores) [21]. They found an overall return to sports rate of 84%. The lowest return to sports rate was seen amongst the linebackers, as one of the three (33.3%) did not return to sports. The reasons why players did not return to sports were not mentioned. The overall career length was statistically significant longer in the control group and after subgroup analysis, with the defensive backs (n = 5) having a statistically significant shorter career length following surgery compared to matched controls [21].

Complications

Relatively few complications were seen in the reviewed studies. Of all studies, only one complication (0.01%) needed surgical intervention: a suture anchor migrated. In one study, two patients had postoperative heterotopic ossifications of the tendon at the site of attachment to the radial tuberosity, but it did not affect their range of motion or functional outcome [20].

Discussion

The main finding of this review is the high return to sports rate (95.3%) for athletes undergoing distal biceps tendon repair and 81.8% returned to the same level. The overall functional outcomes were good and comparable to the unoperated arm or matched controls. The time to return to competition is relatively long (38.8 weeks) and, depending on the sport, not possible within the same season. This should be discussed with the athlete (and potentially the coach) in order to manage expectations. Based on the results of this review, there are several factors that can be associated with a decreased likelihood and increased duration to sports. These factors include injury on the dominant arm, single incision approach, suture anchor technique and a longer duration from injury to surgery.

Return to sports data, such as the time needed to return, are an important measurement of the effectiveness of the rehabilitation and treatment regimens and multiple factors are involved. The recovery of the repair of the distal biceps tendon is relatively long and in case of a

Table 2
Multivariate logistic regression analysis of variables associated with returning to sports in comparison to cortical button [6].

Return to sports at same or higher intensity	n (%)	OR	95% CI	P-value
Interference screw and cortical button (ref: cortical button)	9 (14.8)	0.752	0.527–1.074	0.123
Suture anchor (ref: cortical button)	10 (16.8)	0.602	0.427–0.850	0.006*
Bone tunnel with only sutures (ref: cortical button)	21 (34.4)	0.890	0.688–1.185	0.427
Dominant side surgery	25 (69.4)	0.749	0.582–0.962	0.028*
Single-incision (ref: double-incision)		5.209	1.239–20.903	0.028*

Ref, reference; *OR*, odds ratio; *CI*, confidence interval, *$p < 0.05$.

NFL player, it is unlikely that the player returns within the same season [5]. McGinnis found that the injured players were relatively further along in their career and this could have impacted the return to play rate and level [3]. Additionally, NFL players have a relatively short professional career in general and it could be possible that it is detrimental to miss a season because of an injury. Several of the included studies documented flexion or supination strength deficits, but it did not prove to be of clinical importance in the return to sports rate or level.

In most sports, athletes require the primary use of the dominant arm and if that arm is injured, the time to return to play, especially at the same level, can be prolonged. Multiple studies have demonstrated equivalent of isometric strength in comparison to the contralateral arm following distal biceps tendon repair. However, there is a probability that these results are biased, especially in athletes that work with their dominant arm, the difference in (baseline) strength could be altered [25,33].

Gowd et al. mentioned an increased duration to return to sports with a single incision approach. However, a prior prospective clinical trial, that compared the single-incision approach using suture anchors to the double-incision technique using transosseous tunnels, did not find statistically significant differences in outcomes. Based on the results of this review we cannot conclude if this was of influence on the return to sports rate [17,25]. The decreased likelihood to return to sports following a suture anchor technique was also mentioned as a factor, but differences are small and likely not clinically relevant [6]. Numerous factors influence the strength of a soft–tissue-to-bone fixation construct, including tissue quality, implant strength, contact area and pressure, and tensioning [34]. In the current literature there are indications that more reruptures occur following the suture anchor technique [35]. Several biomechanical studies have shown that the cortical button technique, has a greater load to failure [29]. To date there is no agreement on the optimal surgical approach or technique [17].

The overall complication rate in this study was 0.01%, one patient had a migration of a suture anchor. Heterotopic ossifications were seen in two athletes, but not symptomatic and were therefore not seen as a complication [16]. In other studies, complication rates of 20.4–24.5% are mentioned, and a major complication rate of 4.6% [10,17]. The low complication rate in the included studies could indicate a bias, as athletes that had complications could have been lost in the follow-up. None of the studies mentioned the reason why athletes did not return to sports or to the same level.

The timing from injury to surgery was reported to be a factor for an increased duration for the return to play. Evidence has shown that early distal biceps repair (performed within 4 weeks of injury) does result in statistically significant better outcomes, but the return to previous activity was similar for all patients [13]. However, one can argue that the sooner the athletes are operated, the sooner they will be able to return to play.

An adequate rehabilitation protocol is an important factor for the rate and time of the return to play in general. To date, the rehabilitation protocols are not evidence based, and seemingly based on preference of the publishing surgeon and highly variable [18,36]. In recent studies a trend is seen from longer immobilization periods and slower progression of weight bearing and strength building towards early ROM and aggressive muscle rehabilitation [18,37]. In a few studies, immediate mobilization, as tolerated, showed good clinical results without an increase in complications [38]. Although these were not comparative studies, early loading of the tendon seems to be safe. Early active mobilization may improve the time to return to sports, but further research is necessary.

A limitation to this review is the relatively small patient group, due to relatively few clinical studies in athletes that included the assessment of the return to sports. The heterogeneity in reporting outcomes, the retrospective aspect of the studies, and little information about surgical techniques or rehabilitation protocols are other limitations to this review. The different type of sports (NFL and weightlifting) might also have an impact on the timing and return to sports. The studies were not controlled for potential cofounders including concomitant injuries, trades, personal obligations, coaching changes, or changes in team setup that may have impacted both the case and control cohorts. These factors will likely confound the findings of a decreased postinjury career length and games per season. Lastly, differences in postoperative management could be of influence on the return to previous level of play and complications. It is necessary to elucidate whether early ROM and an aggressive rehabilitation protocol improves the return to sports. A standardized protocol for reporting outcome measures, including return to sports rate, timing and strength measurements, is necessary for further research. All these factors can be important for the timing and rate of the return to play to the same level.

Conclusion

To conclude, 95.3% of the athletes with repair of the distal biceps tendon returned to sports and 81.8% to the same preinjury level of competition. The functional outcomes following surgery were good and generally not clinically different compared to matched athletes. The average time to return to sports was 38.8 (range 27.6–50) weeks, depending on type of sport. The relatively long rehabilitation period before returning to competition is important to discuss with the athlete in order to manage expectations. Early mobilization following distal biceps tendon repair might have a positive influence on the return to sports rate. Future research is necessary to compare surgical techniques, rehabilitation program and functional outcomes in order to draw conclusions about factors on return to sports.

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