

The Use of Imagery in Athletic Injury Rehabilitation. A Systematic Review

*Der Einsatz von Imagery bei der Rehabilitation von Sportverletzungen.
Ein systematisches Review*

Summary

- › **Background:** Depending on the injury, athletes experience not only significant physiologic impairments, psychological stress is also a consequence that should not be underestimated. Therefore, holistic, multimodal care is essential for optimal recovery. A method that is already successfully used in the area of performance enhancement is imagery. The aim of this work is to provide a systematic review of current studies on the use of this method in the rehabilitation of sports injuries.
- › **Method:** This systematic review follows the guidelines of the PRISMA-Statement. German and English primary studies that investigate imagery intervention in the context of sports injuries, were included.
- › **Results:** A total of nine studies were identified, which are very heterogeneous in terms of study design, interventions and dependent variables. Several studies demonstrated the efficacy of imagery on different muscle areas. Imagery also contributed to the remission of fear of reinjury. There were contrary findings regarding the reduction of perceived pain. Overall, the significance of the studies included is limited due to the insufficient sample sizes.
- › **Discussion:** Despite broad inclusion criteria, only a small number of studies could be found. The results have rather indicative value due to the quality of the studies included and should be secured by further RCT. The work presented illustrates the need for high quality studies in this area.

KEY WORDS:

Mental Techniques, Injury,
Multimodal Rehabilitation

Zusammenfassung

- › **Problemstellung:** Sportler erfahren je nach Verletzung nicht nur erhebliche physiologische Beeinträchtigungen, auch psychologische Belastungen sind nicht zu unterschätzende Folgen. Eine ganzheitliche, multimodale Betreuung ist für eine optimale Genesung daher unerlässlich. Ein Verfahren, das im Bereich der Leistungssteigerung bereits erfolgreich eingesetzt wird, ist Imagery. Ziel dieser Arbeit ist eine systematische Literaturübersicht der aktuellen Studienlage zum Einsatz dieses Verfahrens bei der Rehabilitation von Sportverletzungen.
- › **Methode:** Dieses systematische Review orientiert sich an den Leitlinien des PRISMA-Statements. Eingeschlossen wurden deutsch- und englischsprachige Primärstudien, die eine Imagery-Intervention im Zusammenhang mit Sportverletzungen untersuchen.
- › **Ergebnisse:** Insgesamt wurden neun Arbeiten identifiziert, die in Bezug auf Studiendesign, Interventionen und abhängige Variablen sehr heterogen sind. Mehrere Studien können die Wirksamkeit von Imagery auf verschiedene Muskelbereiche nachweisen, ebenso konnte Imagery zu einer Remission der Wiederverletzungsangst beitragen. Bezüglich der Reduktion wahrgenommener Schmerzen ergaben sich konträre Ergebnisse. Die Aussagekraft der eingeschlossenen Studien ist aufgrund der unzureichenden Stichprobengrößen insgesamt limitiert.
- › **Diskussion:** Trotz weiter Einschlusskriterien konnte nur eine geringe Anzahl an Studien gefunden werden. Die Ergebnisse haben aufgrund der Qualität der eingeschlossenen Studien eher hinweisenden Charakter und sollten durch weitere randomisiert-kontrollierte Studien gesichert werden. Die dargestellten Arbeiten verdeutlichen den Bedarf an qualitativ hochwertigen Studien in diesem Bereich.

SCHLÜSSELWÖRTER:

Mentale Techniken, Verletzung,
multimodale Rehabilitation

Introduction

During the 2014 FIFA World Cup, 3.4 million spectators visited the World Cup stadiums in Brazil. The final between Argentina and Germany alone was followed by approximately 695 million viewers in private households (20). These figures illustrate the importance of sport, particularly soccer in today's society. As a tragic hero of the German national soccer team, Ilkay Gündogan could not participate in

the tournament due to a spinal compression. Such injury breaks are not uncommon in contact sports like soccer, basketball or handball. In a soccer season, there are approximately 2.5 injuries per player, each resulting in an average downtime of 14.5 days (9). The clubs accordingly lack on average three players throughout the season (about 12% of the team) due to injuries. This entails enormous

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Table 1

Overview of the search results of the different search engines.

	LIVIVO	PUB- PSYCH	PSYCH- INFO	PUBMED	TOTAL
Imagery	2261	54	209	190	2714

costs at the club and association level (absence despite continued payment of the salary, rehabilitation measures, medical care). As a result, clubs are increasingly investing in professional medical care.

For professional and competitive athletes, the consequences of an injury are not just physiological. Numerous personal, situational, emotional and psychological factors also play an important role (37). Previous studies on sports injuries have demonstrated the influence of physiological and psychological factors on the frequency of injuries, the cognitive assessment, the rehabilitation process and its duration (18, 37). Injury experiences can cause feelings of frustration, depression, anxiety, anger and isolation (19). Therefore, a holistic, multiprofessional approach (medical, physiotherapeutic, psychological) should be sought when dealing with sports injuries. Surprisingly, psychological interventions supporting the rehabilitation of sports injuries have only attracted increasing attention in recent years. By contrast, these methods are already widely used to improve performance. Techniques such as self-instruction training, goal-setting training or relaxation techniques are used effectively in many different sports (12, 28, 35).

Imagery in particular is cited as a promising method in almost every sport psychology textbook (24) and is also described as visualization. The use of imagery has been examined in numerous research studies. The effectiveness has been proven particularly in the area of training and competition (25, 29). Only a few empirical studies exist in the field of rehabilitation of sports injuries (32).

In this paper, a literature review of the current studies on the use of imagery in the rehabilitation of sports injuries is compiled and the quality characteristics of the individual studies are summarized. It is assumed that, by reviewing the available literature, fields of application can be highlighted that should be empirically explored in the future.

Method

The methodical procedure was adapted from the guidelines of the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) and implemented accordingly (23). The PICO format was used to specify the research question more precisely:

- **Population:** athletes who have experienced a sports injury.
- **Intervention:** the use of imagery.
- **Comparison/Control:** previous treatments (physiotherapy alone) or consequences of sports injuries.
- **Outcome:** improved rehabilitation of sports injuries.

The following databases, meta-databases and search portals were included in the literature search: LIVIVO, Pubmed, PsycInfo, PubPsych. The search period was not limited and therefore ranged from the beginning of the database until August 2016. Since the quality of the search results is very heterogeneous and the number of studies found is sometimes very large (up to 20,000 results), the general literature research Google Scholar was only used as a supplementary source.

Selection Criteria

The predefined inclusion criteria were very broad due to the current state of research on the use of imagery in sports injuries:

- German and English primary studies.
- Studies investigating an imagery intervention related to a sports injury.

No limitations were made regarding the study design, age, gender, type of sport or injury. The search terms imagery, sports injury and rehabilitation were used in both German and English.

The combination of the search terms was carried out by means of the Boolean operators "AND"/"OR". The restriction "sport" was additionally added for the search term combination "imagery rehabilitation", as the publications found were from very broad subject areas. In addition, when reviewing the literature, the proposals for further and similar articles were included. Finally, the abstracts and full texts were independently checked for inclusion and exclusion criteria, study quality and assessment of RoB by two persons.

The Risk of Bias for the different study designs was evaluated with a total of three evaluation schemes: 1. Manual for the evaluation of RoB in clinical trials by the Cochrane Collaboration Germany (1), 2. RoB of nonrandomized trials (ACROBAT-NRSI) (1), 3. Classification of the RoB for intervention studies without control group (Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group) of the US Department of Health & Human Services (30).

Results

In the literature search, a total of 2714 studies were found. Table 1 gives an overview of the studies found by the various search engines. Furthermore, 21 additional studies were identified using the proposals for related and similar articles. After reviewing the inclusion and exclusion criteria, nine research papers were included in the review. A flow chart has been created for clear presentation of this process (see Figure 1).

The publication period of the studies ranged from 2001 to 2016, with eight of the nine studies published in the past ten years. In order to obtain a better overview, Table 2 depicts information about the author, year, country, journal, title, number of subjects, intervention and type of sports injury of the studies.

Injuries

A large part (n = 6) of the studies focused on the analysis of specific sports injuries. More than half investigated lower extremity injuries, three studies did not specify any restrictions regarding sports injuries (15, 16, 31), one study included concussions (11).

Interventions

In total, nine different imagery interventions were used in the studies found (see Tab. 15). More than half indicated that relaxation exercises were included either before or during the imagery interventions (2, 3, 6, 15, 31), the imagery scripts however differed for each intervention. In the majority of the studies, the individual contents of the imagery sessions were adapted from the current state of rehabilitation or the physiotherapeutic treatments.

Dependent Variables

A total of 35 different dependent variables were collected, 24 of which are based on subjective statements (e.g. questionnaires, scales) of the participants. Only three instruments were used in more than one study: self-efficacy in rehabilitation (AISEQ), use of imagery (AIIQ-2), and perceived pain (VAS).

Study Design

Three studies were intervention trials without a control group. Nearly half (four out of nine) were experimental studies with randomized assignment of subjects to experimental and control groups. Two authors carried out quasi-experimental studies without randomization.

Risk of Bias

The experimental studies with randomization showed very different results regarding RoB. In two studies, no evaluation could be made due to insufficient information. One study each had a high RoB (6) and a low RoB (2). In the quasi-experimental studies, which are already of lower quality compared to RCT, one study was rated moderate RoB (5) and one critical RoB (16). The intervention studies without a control group also showed very heterogeneous RoB, with one good (11), one poor (15) and one sufficient assessment (31).

Study Quality

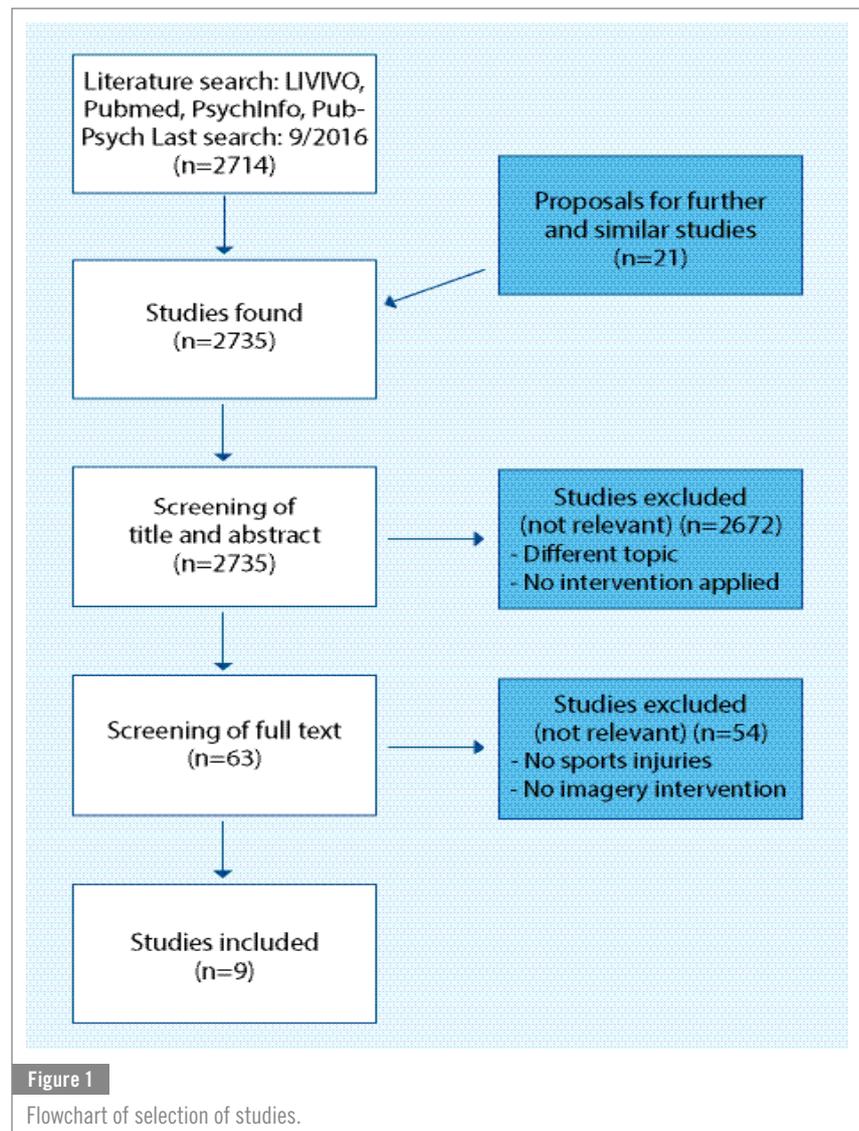
Overall, the quality of the included studies is not convincing due to insufficient sample size, lack of blinding and incomplete data (see Tab. 3). Only the study by Cupal & Brewer (6) achieved three points, which is considered adequate. Six studies were rated with one point, two with two points. None of the studies implemented the criteria for double-blind experiments.

Study Results

In summary, the imagery interventions showed positive influences on the following variables:

- satisfaction with the rehabilitation process (5)
- strength endurance (3)
- strength of the knee (6)
- musculature (22)
- self-assurance (15)
- mood and energy (11).

In addition, imagery contributed to a remission of reinjury anxiety, perceived pain (6), and post-concussion symptoms (11). In the study by Lebon et al. (22), no differences were reported between the groups in terms of perceived pain. The effectiveness of imagery on self-efficacy, the return to play time (5), functional stability and dynamic balance (3), pain, edema, mobility of the ankle (2, 22) could not be confirmed.



Discussion

Overall, the studies show a high degree of heterogeneity in terms of study design, variables and interventions. Consequently, a clear and concise answer regarding the effectiveness of imagery in the rehabilitation of sports injuries proves to be difficult.

Case Numbers and Sampling Procedure

Overall, the number of participants lies between 2 and 30, with an average value of $m=14\pm 8.5$. Consequently, a large part of the examined groups has less than ten participants, when using a control group. The sample sizes can be considered as low, leading to possible bias and decreasing the validity of the statistical results (14). The probability of a type II error can be considered as high for all studies.

Injuries

The majority of the authors (six out of nine) examined specific sports injuries (2, 3, 5, 6, 11, 22). This approach is to be supported due to the high variability of consequences of sports injuries. The effect of an imagery intervention can also be influenced by the type of injury. Studies examining athletes with different injuries should therefore control for confounding variables in the statistical evaluation. The works of >

Table 2

Characteristics of the studies selected.

AUTHOR	YEAR	COUNTRY	JOURNAL	TITLE	N	INTERVENTIONS	SPORTS INJURIES
Cressman & Dawson	2011	Canada	Journal of Imagery Research in Sport and Physical Activity	Evaluation of the Use of Healing Imagery in Athletic Injury Rehabilitation	9	Internal and external healing imagery	Grade II ankle sprain or strain
Christakou et al.	2007	Greece	Human Movement Science	The adjunctive role of imagery on the functional rehabilitation of a grade II ankle sprain	20	Imagery sessions	Grade II ankle sprain
Christakou & Zervas	2007	Greece	Physical Therapy in Sport	The effectiveness of imagery on pain, edema, and range of motion in athletes with a grade II ankle sprain	18	Physiotherapy and imagery with relaxation	Grade II ankle sprain
Cupal & Brewer	2001	USA	Rehabilitation Psychology	Effects of Relaxation and Guided Imagery on Knee Strength, Reinjury Anxiety, and Pain Following Anterior Cruciate Ligament Reconstruction	30	Relaxation and guided imagery	Anterior cruciate ligament (ACL) reconstruction
Gagnon et al.	2016	Canada	Scandinavian Journal of Medicine & Science in Sport	A pilot study of active rehabilitation for adolescents who are slow to recover from sport-related concussion	10	Active rehab programm with visualisation, aerobic, coordination, imagery	Sport-related concussion
Handegard et al.	2006	USA	Journal of Excellence	Relaxation and Guided Imagery in the Sport Rehabilitation Context	2	Relaxation and guided imagery	rotator cuff tendon tear, fractured left radius
Holler	2014	USA	Master thesis- Graduate School Southern Illinois University Edwardsville	The Use of an Imagery Education Program to Enhance Imagery Use, Self-Efficacy and Return to Sport Time in Athletes with a Sport Related Injury	19	Imagery-education-program	All types of injuries
Lebon et al.	2012	France	Applied Psychophysiology and Biofeedback	Increased Muscle Activation Following Motor Imagery During the Rehabilitation of the Anterior Cruciate Ligament	12	Motor imagery	Arthroscopic ACL reconstructive
Shapiro	2009	USA	Dissertation, College of Physical Activity and Sport Sciences at West Virginia University	An individualized multimodal mental skills intervention for college athletes undergoing injury rehabilitation.	6	Mental skills training: goal setting, relaxation, imagery, self-instruction	All types of injuries

Handegard et al. (15), Holler (16) and Shapiro (31) do not comply with this demand.

Interventions

The interventions of the studies found differ considerably from one another. Five studies (2, 3, 6, 15, 31) indicate that imagery interventions are combined with relaxation techniques, which are usually used at the beginning of an intervention. Various opinions can be found in the literature concerning this matter. On the one hand, relaxation can be used as an introduction to focus and to suppress distractions (36). A widespread imagery technique (VMBR-Visuo-Motor Behavior Rehearsal) by Suinn (33) even requires the use of relaxation before the use of imagery. Although this opinion seems to be widespread, only few empirical results can be found supporting this belief in the field of sport psychology (17, 26). A high level of relaxation could even be considered obstructive for practical imagery applications such as the successful execution of a movement or the successful overcoming of an opponent. The use of relaxation in combination with imagery should therefore always

be adapted to the current content. This approach is also implemented in the study by Lebon (22). Here, relaxation is only used at the beginning of the first imagery sessions to ensure the concentration of the participants. Thereafter, participants are instructed to increase their level of arousal to the level of the actual physical performance.

A comparison is impeded by the various imagery interventions. In practice, an approach that adapts to the individual and situational needs of an injured athlete is certainly preferable. Nevertheless, in order to ensure a minimum of objectivity, a rough breakdown of the single steps of the interventions could be made, which would still provide enough space for individual adjustments. Also, a collection of imagery scripts used for different applications could contribute to a higher standardization.

Study Design

One-third of the studies found are intervention studies without a control group (11, 15, 31), also called before-and-after study. This study design is given a low value in empirical re-

Table 3

Overview of the quality of studies included; (X=criterion is met; -=criterion is not met).

AUTHOR	RANDOMIZATION	DOUBLE BLINDING	DROP-OUT	RANDOMIZATION APPROPRIATE	DOUBLE BLIND APPROPRIATE
Cressman & Dawson 2011	-	-	X	-	-
Christakou et al. 2007	X	-	-	X	-
Christakou & Zervas 2007	X	-	-	X	-
Cupal & Brewer 2001	X	-	X	X	-
Gagnon et al. 2016	-	-	X	-	-
Handegard et al. 2006	-	-	X	-	-
Holler 2014	-	-	X	-	-
Lebon et al. 2014	X	-	-	-	-
Shapiro 2009	-	-	X	-	-

search, since a change can not necessarily be attributed to the intervention, but could also be the result of other factors, e.g. Hawthorne effect or the natural healing process (11). The informative value of a study without a control group is limited accordingly.

Despite all this, case studies also provide valuable information and should not be ignored. Almost half of the studies used an experimental design with random allocation of participants. It should be noted that the studies contribute to gaining scientific knowledge, rather than validating hypothesis, which also reflects the current state of research. Only the study by Cupal & Brewer included a control, experimental and placebo group. In addition, this study includes significantly more subjects (30 participants) than the other studies and the period of investigation covers a total of 15 months.

Risk of Bias

Due to the different study designs, several evaluation schemes have to be used to determine the RoB. A comparison of the RoB among different study designs should be avoided accordingly. A randomized controlled trial may have a high RoB within the evaluation scheme (Cochrane Deutschland), nevertheless the significance of these results is higher than that of an intervention study without a control group with a low evaluation of RoB (13). The majority of the studies do not give information about blinding. None of the studies ensures blinding of the participants, the researcher, the tester, and the evaluator (double-blind procedure). In four studies (2, 15, 16, 31) the person performing the intervention is also the author of the study, which can lead to considerable distortions (e.g. experimenter bias) and should be avoided (10).

Study Results

Despite some methodological shortcomings, the studies allow statements about the effectiveness of imagery in the rehabilitation of sports injuries. No significant group differences are reported in the study by Cressman & Dawson (5), but there is a tendency for the intervention group to be more satisfied with rehabilitation from week 2 to week 3. This result is supported by the study by Ievleva & Orlick (18), in which athletes using imagery also have a positive attitude towards rehabilitation. The difference between week 2 and week 3 is interesting, since external imagery contents were applied in the third week. The change from visualizing endogenous healing processes to objectives regarding rehabilitation leads to an increase in satisfaction. The visualization of positive goals such as successful

return to competition can help to maintain motivation and self-esteem during prolonged injury breaks, which in turn has a positive effect on the rehabilitation outcome (37).

The studies by Christakou et al. (3), Cupal & Brewer (6) and Lebon et al. (22) demonstrate the efficacy of imagery on different muscle areas (muscle endurance, knee strength, and muscle activation) of the lower limbs. The studies are not directly comparable with respect to the injuries (ankles, knees), but they are supported by the results of further studies (4, 38). One possible explanation can be found in a study by Yue & Cole (38). Here, no differences were found regarding the maximum muscular strength of a training group (training 5x per week, 4 weeks) compared to an imaginary group, which merely imagined the movements. Training effects or changes of the centrally controlled motor programs are mentioned as an explanation. This view is supported by the results of the study by Lebon et al. (22). In their study, the size of the quadriceps femoris muscle in the control and imagery groups declined to the same extent over the study period, although an increase in muscle activation is reported for the imagery group, which could therefore be explained by neuronal rather than structural changes. The study by Christakou & Zervas (2) confirms the impression that the applied imagery intervention has no influence on structural factors of the knee. These findings are particularly important for athletes with fixation of injured body parts. The loss of muscle strength is severe in the first week after immobilization, which is attributed to adjustments of neuromotor processes (27). These adaptation processes can be counteracted through targeted imagery training.

The positive impact of imagery on pain management has been demonstrated in several surveys (7, 8, 21). Regarding the studies found in this work, there are contrary results. In the study by Cupal & Brewer (6), the intervention group (using relaxation and imagery) experience significantly less reinjury anxiety and less pain than the placebo and control groups. The calculation of the effect size indicates lasting effects on psychological and physiological rehabilitation parameters. The studies by Christakou & Zervas (2) and Lebon et al. (22) can not replicate these results. In the latter study, this could be attributed to the contents of the intervention, which are primarily aimed at mental representations of movements and only include pain management in the first session. In addition, study participants received highly effective analgesics in the first few weeks, which could also influence pain perception over the observation period. Overall, the palliative effect >

of imagery, especially in cancer therapy, has been empirically proven (34), further research is needed in the field of sports psychology.

The results of the studies by Gagnon et al. (11) (remission of post-concussion symptoms, less fatigue, improvement of mood), Handegard et al. (15) (increased self-confidence) and Shapiro (31) should be used to generate further hypothesis due to the study design (without control group) and the small sample sizes. Further research, especially RCT, is needed to confirm these findings. The number of dependent variables for which the effectiveness of imagery intervention has not been demonstrated, e.g. self-efficacy and return to play time (5), functional stability and dynamic balance of the ankle (3), may also be related to the small sample sizes. If the sample size is too small, existing significant differences between the study groups may not be recognized (14).

Outlook

This review provides insight into the effectiveness of imagery interventions in the context of sports injuries, the state of research and methodological characteristics of the studies found. The need for high-quality studies has here become clear. In addition, the small population of studies should be cited as a limitation. Future research should use sufficiently large samples, carry out proper randomization and control possible experimenter bias by blinding. In order to increase the validity and to make comparisons between studies, methodical standards are necessary.

As long as sufficient standards do not exist, the influential parameters (study design, selection criteria for subjects, sport, interventions, etc.) should be described in detail to allow replication. Consequently, the imagery scripts used should always be published in the appendix of the studies. The use of sufficiently large samples would allow the examination of other influential factors (gender, type of injury, age, etc.). ■

Conflict of Interest

The authors have no conflict of interest.

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