

Almeida, M.; Carvalho, A.; Riboldi, A.; Uribe, J. y Lopes, A. (2013). Síndrome del codo de portero de balonmano: una revisión sistemática / Handball goalie's elbow syndrome: a systematic review. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 13 (52) pp. 831-844. [Http://cdeporte.rediris.es/revista/revista52/artsindrome414.htm](http://cdeporte.rediris.es/revista/revista52/artsindrome414.htm)

REVISIÓN / REVIEW

HANDBALL GOALIE'S ELBOW SYNDROME: A SYSTEMATIC REVIEW

SÍNDROME DEL CODO DE PORTERO DE BALONMANO: UNA REVISIÓN SISTEMÁTICA

Almeida, M.¹; Carvalho, A.²; Riboldi, A.³; Uribe, J.⁴ & Lopes, A.⁵

- 1 Programa de Maestría en Fisioterapia de la Universidade Cidade de São Paulo (UNICID), São Paulo – SP, Brasil, mathewsalmeida@hotmail.com
- 2 Programa de Maestría en Fisioterapia de la Universidade Cidade de São Paulo (UNICID), São Paulo – SP, Brasil, alinecca@hotmail.com
- 3 Coordinador del sector de Fisioterapia de la Academia Traffic de Futebol, Porto Feliz – SP, Brasil, augustolbr@hotmail.com
- 4 Fisioterapeuta, Universidad CES, Medellín, Colombia, josevelezu@hotmail.com
- 5 Programa de Maestría en Fisioterapia de la Universidade Cidade de São Paulo (UNICID), São Paulo – SP, Brasil, aledlopes@yahoo.com.br

Spanish-English translator: Matheus Oliveira de Almeida
mathewsalmeida@hotmail.com

Código UNESCO / UNESCO Code: 3201. Ciencias Clínicas / Clinical Sciences
Clasificación Consejo de Europa / Council of Europe classification: 11.
Medicina del deporte / Sports Medicine

Recibido 3 de agosto de 2011 **Received** August 3, 2011
Aceptado 8 de febrero de 2012 **Accepted** February 8, 2012

ABSTRACT

Elbow injuries in handball goalkeepers usually happen by ball impact during blocks exposing elbow joint to repetitive traumas in hyperextension position. The objective of this study was to realize a systematic review about handball elbow injuries in goalkeepers. A database search was conducted in Medline via Pubmed, Embase, SportDiscus and Lilacs. The quality of studies included was assessed using a modified and adapted checklist. The search results identify a total of 623 papers, and only ten articles were included in our review. The results of included articles demonstrated that handball elbow injuries have a high incidence, and the mechanism of this injury is repetitive traumas in elbow hyperextension by ball contact in forearm region.

KEY WORDS: athletic injuries, sports, cumulative trauma disorders

RESUMEN

Las lesiones en el codo de los porteros de balonmano ocurren en general generalmente por el debido impacto de la pelota durante la defensa. El objetivo del presente estudio fue realizar una revisión sistemática de la literatura sobre los aspectos relacionados a esta lesión. Se realizó una búsqueda en Medline, Embase, SportDiscus y Lilacs. La calidad de los artículos incluidos fue evaluada a través de una versión modificada y adaptada de una escala. La búsqueda identificó un total de 623 artículos, de los cuales solo diez de ellos fueron incluidos. Los resultados de estos artículos demostraron una alta incidencia de lesiones en porteros de balonmano, con el mecanismo de lesión por traumas repetitivos que fuerzan la hiperextensión del codo.

PALABRAS CLAVE: lesiones deportivas, deportes, trastornos de trauma acumulativo

INTRODUCTION

The International Handball Federation has more than 120 member countries, with more than 12 million players registered throughout the world (Akgun, Karahan, Tiryaki, Erol, & Engebretsen, 2008). In contrast with other sports, there are few studies that have evaluated specific handball injuries. This sport, however, involves a high risk of injuries, principally because of direct contact with others players, movements with changing directions, and high shoe-surface direction (Nielsen & Yde, 1988; Strand, Tvedte, Engebretsen, & Tegnander, 1990).

Playing handball was the second cause of sports injuries in Europe, with an incidence of 10 injuries per 1000 hours played (Nielsen & Yde, 1988). In a study with German teams, the injury incidence was 0.6 per 1000 practice-hours (Seil, Rupp, Tempelhof, & Kohn, 1998). Even lower extremities are most affected in handball injuries (Dirx, Bouter, & de Geus, 1992; Seil et al., 1998; Wedderkopp, Kaltoft, Lundgaard, Rosendahl, & Froberg, 1997), special attention has been given to elbow injuries, which represent around 7% of all injuries related to this sport, principally among the goalkeepers (Wedderkopp et al., 1997).

In contrast to other sports, in which elbow injuries are related to throwing, that overloads the medial structures of the elbow (Jobe & Nuber, 1986; Johnston, Plancher, & Hawkins, 1996), elbow injuries in handball occurred because of ball impact on the forearm when goalkeepers blocked the opponent's throw. The ball in handball weighs more than 400 grams and can reach speeds higher than 120 Km/h (Tyrdal & Bahr, 1996). The goalkeepers usually block a ball with fully extended arms, and, unlike other sports, they do not try to catch the ball. They use the forearm or the hands to block the ball, exposing the elbow joint to repetitive overloads in hyperextension. The set of signs and symptoms that affect the elbow region associated with this injury mechanism is described as a syndrome called "handball goalie's elbow" (Tyrdal & Bahr, 1996).

Despite the importance of this injury in handball players, especially among goalkeepers, it is not possible to find systematic reviews about it. In fact, there are only a few studies about this issue. This systematic review is a pioneer study about handball goalie's elbow, so the objective of this present study was to review different aspects related to the elbow injury that affects the goalkeepers, focusing on epidemiology, etiology, and clinical symptoms.

METHODS

In order to do this systematic review, the guidelines proposed by PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) were used, whereas some items were not applicable owing to included studies designs. Studies about elbow injuries in handball goalkeepers were included. There were no

restrictions about language, date of publication, or study design. Studies were identified through a search in the following databases: Medline via PubMed; Embase; SportDiscus; and Lilacs until March 31, 2011. The search was adjusted to each database according to its characteristics (Table 1). References from studies found were also searched.

Table 1. Search strategies used in each database

Embase	PubMed	Sportdiscus
1 injury	1 injury	1 handball injuries
2 sport injury	2 sport injury	2 Limits: scientific journal
3 (1 OR 2)	3 (1 OR 2)	3 Limits: thesis
4 handball	4 handball	4 (1 AND 2 AND 3)
5 (3 AND 4) OR 5	5 (3 AND 4) OR 5	Lilacs
6 <Limit> humans	6 <Limit> humans	1 handball injuries
7 (6 AND 7)	7 (6 AND 7)	

The studies were evaluated and selected first through titles and abstracts. Selected articles had their full texts accessed, and those that met the inclusion criteria were included in the review. After that, data was extracted from each study, including information about study design, sample size, sample characteristics, outcomes, and results. The reviewers were not blind to authors, institutions, or journals of all the studies.

A methodological quality assessment was done using a modified version of the scale by Downs and Black (Downs & Black, 1998) (Table 2). The scale comprised 12 items, each of which was classified as positive (+) if the item was well described, or negative (-) if the item was not well described. The final score was calculated by the number of items classified as positive, multiplied by 100. The following items were analyzed: 1) Objective/Hypothesis: the objective or hypothesis was well defined; 2) Sample characteristics: characteristics of the sample were well defined; 3) Study sample: the sample was representative of the studied population; 4) Case-controls' characteristics: cases and controls have same characteristics and can be compared; 5) Description of the outcomes: description of outcomes in the methods section; 6) Validity and reliability of results: the tools used to evaluate the outcomes were valid and reliable; 7) Presentation of results: results were well reported; 8) Variability measures: measures of variability were reported, such as standard deviation, standard error, and confidence interval; 9) p-value: probability values were reported; 10) Blinding: the evaluators were blinded; 11) Study follow-up: loss of sample higher than 15%; 12) Sample size: the sample size was adequate.

Table 2. Evaluation of quality assessment of included studies

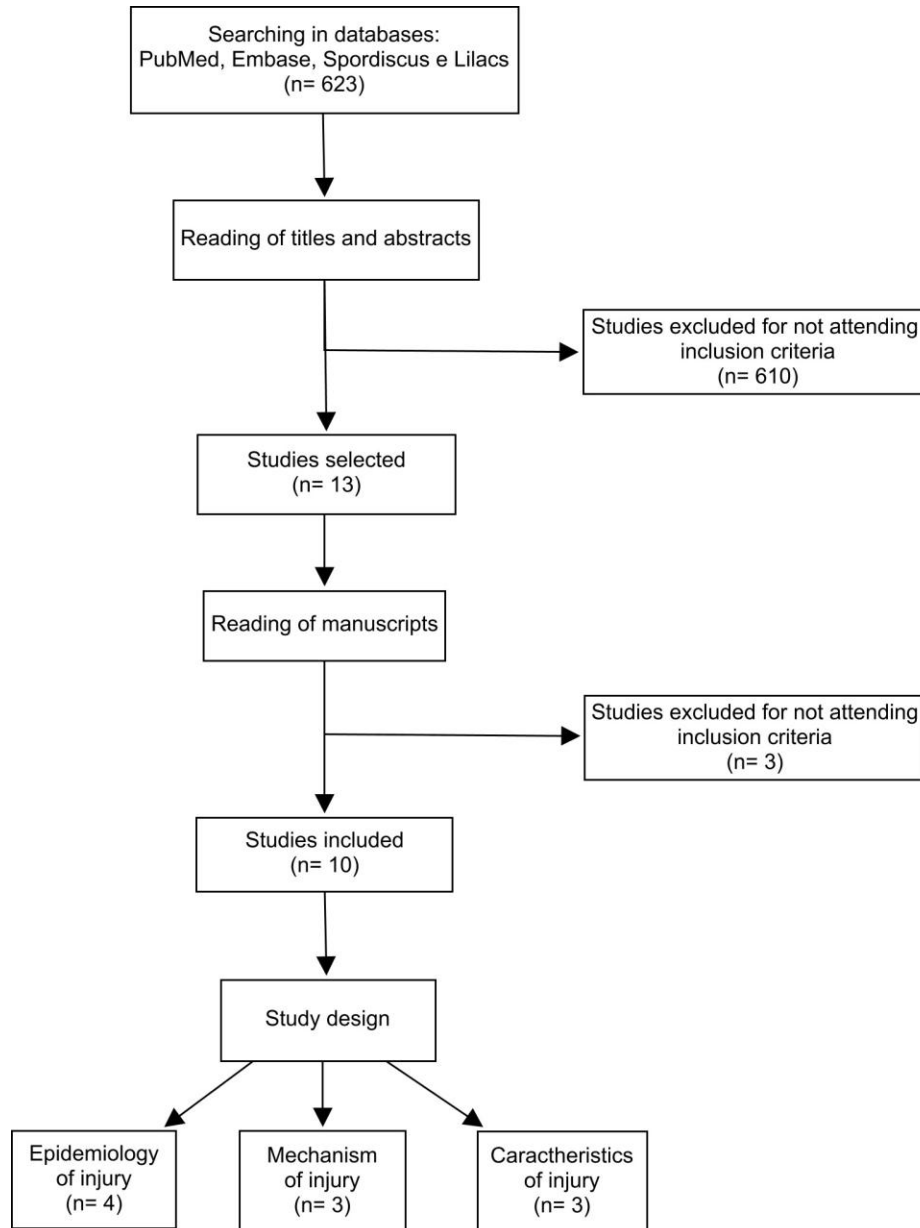
1- Are objectives and hypothesis defined?	CS / CC / P
2- Are sample characteristics of the study described?	CS / CC / P
3- Is the study sample representative?	CS / CC / P
4- Do cases and controls have same characteristics?	CC
5- Are the outcomes well described in methods section?	CS / CC / P
6- Are results valid and reliable?	CS / CC / P
7- Are main results well described?	CS / CC / P
8- Is it used variability measures for the main outcomes? (Standard deviation, standard error, confidence interval)	CS / CC / P
9- Have actual probability (p) values been reported?	CS / CC / P
10- Are results evaluators blinded?	CS / CC / P
11- Did significant loss of sample (>15%) happened?	P
12- Is sample size adequate?	CS / CC / P

CS= cross-sectional; CC= case-control; P= prospective

RESULTS

Ten studies about elbow injuries in handball goalkeepers were included in this review. The search strategy provided a total of 623 articles, whereas after the selection process and inclusion criteria were applied, just 10 studies were selected for the review (Figure 1).

Figure 1. Flow diagram of search and inclusion process of studies



Regarding study designs, three were classified as prospective; two as retrospective (the same study was classified as retrospective and prospective); two were case-control studies; and four were cross-sectional studies. Three studies evaluated the elbow injuries using diagnostic tests and clinical findings. Three evaluated the mechanism of injury, and four evaluated the epidemiology of elbow injuries in handball goalkeepers. The summary of the included studies are displayed in Tables 3, 4, and 5.

Table 3. Description of studies about injury epidemiology

Study	Design	Methods	Outcomes	Results	Conclusion
Tyrdal 1996	Retrospective / Prospective	- Questionnaire about occurrence and presence of injuries - 304 teams - 4849 players	- Incidence of injuries - Characteristics of injuries - Characteristics of players	- 45% of goalkeepers reported elbow pain -34% reported previous injuries in this region -8.6% of goalkeepers have a new injury in the elbow during the season	Goalkeepers are very susceptible to injuries in the elbow joint.
Wedderkop 1997	Retrospective	- Questionnaire about occurrence and presence of injuries - 23 teams - 209 players	- Incidence of injuries - Injuries distribution by player position - Characteristics of injuries	- Incidence of 40.7 injuries /1000 match hours - 5% of injuries in elbow joint	Elbow injuries are not so frequent when compared with others regions.
Seil 1998	Prospective	- Questionnaire about occurrence of injuries - 16 equipes - 186 players	- Incidence of injuries - Type of injury - Characteristics of injuries	- Incidence of 14.3 injuries/1000 match hours - The elbow represent 8% of total injuries by overload	Elbow injuries represent only a small part of total injuries in handball.
Langervoot 2007	Prospective	- Questionnaire about occurrence and type of injuries diagnosed by medical staff - 6 main international profesional tournaments	- Incidence of injuries - Type of injury - Characteristics of injuries - Injury place	- Incidence of 108 injuries/1000 hours (95% IC: 98-117) - 7% of injuries in one tournament affected the elbow	Injury incidence in the elbow was small when compared with other regions.

Table 4. Description of studies about injury mechanism

Study	Design	Methods	Outcomes	Results	Conclusion
Tyrdal 1998a	Cross-sectional	<ul style="list-style-type: none"> - Kinematic evaluation of 9 cadaveric elbows - Use of progressive loads in anterior forearm part causing elbow hiperextension 	<ul style="list-style-type: none"> - Range of motion of elbow extensión - Elbow integrity structures 	<ul style="list-style-type: none"> - Improve of 19.8° (\pm 2.3°) in range of motion for elbow extension - Anterior capsule lesions - Partial rupture of medial and lateral collateral ligament - Olecranon cartilage lesions 	<p>Repetitive traumas in hiperextension can cause articular lesion in the elbow. Injury mechanism may be related to repetitive loads in hiperextension of the elbow.</p>
Tyrdal 1998b	Cross-sectional	<ul style="list-style-type: none"> - Kinematic evaluation of 10 cadaveric elbows - Use of progressive loads in ulna and radio regions causing elbow hiperextension 	<ul style="list-style-type: none"> - Range of motion of elbow extensión - Elbow integrity structures 	<ul style="list-style-type: none"> - Improve of 20.9° (\pm 2.3°) in range of motion for elbow extension - Anterior capsule lesions - Partial rupture of medial and lateral collateral ligament - Ulna cartilage lesions 	<p>Repetitive traumas in hiperextension, in distal ulnar or radial region, can cause articular lesion in the elbow. It appears to exist a relation between this mechanism and handball goalkeepers elbow injuries.</p>
Tyrdal 1998c	Cross-sectional	<ul style="list-style-type: none"> - Kinematic evaluation of 10 cadaveric elbows - Use of progressive loads causing elbow hiperextension with forearm in supination 	<ul style="list-style-type: none"> - Range of motion of elbow extensión - Elbow integrity structures 	<ul style="list-style-type: none"> - Improve of 16.7° (\pm 8.7°) in range of motion for elbow extension - Anterior capsule lesions - Avulsion of medial and lateral collateral medial y lateral - Rupture of lateral collateral ligament 	<p>Repetitive traumas in hiperextension with forearm in supination are more associated with injuries in lateral structures of elbow joint.</p>

Table 5. Description of studies about lesions' characteristics

Study	Design	Methods	Outcomes	Results	Conclusion
Tyrdal 1999	Case-control	- Radiographic evaluation (anterior, posterior view, with and without valgus stress) - 74 injured elbows - 18 uninjured elbows	- Osseous lesions - Medial instability - Loss of elbow extension - Carrying angle	- No significant osseous lesions - No correlation between clinical, radiographic evaluation and symptoms' localization	The radiographic evaluation didn't help in handball goalie's elbow.
Rise 2001	Cross-sectional	- Neurophysiological examination - 10 recreational goalkeepers with parestesias in forearms and hands	- Clinical evaluation - Motor conduction velocity	- No changes in motor conduction velocity of ulnar and median nerves, and neither in neurological clinical evaluation	Neurological and neurophysiological changes are less usual in handball goalkeepers with elbow injuries.
Popovic 2002	Case-control	- Radiographic evaluation (anterior, posterior view, with and without valgus stress) and ultrasonography - 30 handball goalkeepers - 30 controls	- Osseous lesions - Radiographic medial instability - Soft tissue lesions	- It was found osteophyte formation (67%) - Alterations of colateral medial ligament (50%), cartilage lesions (18%) and intra-articular effusion (66%)	Repetitive overload in elbow hyperextension due to ball impact can cause osseous and soft tissue alterations of elbow joint.

The results and final score from methodological quality assessment are described in Table 6. The average score from all studies was about 65%. Items that resulted in further loss of score were: reporting probability values; evaluators' blinding and sample size. Studies about epidemiology showed best results with an average score nearly 80%.

Table 6. Methodological quality assessment of included studies

Studies	1	2	3	4	5	6	7	8	9	10	11	12	Total
<i>Tyrdal, 1996</i>	+	+	+	n/a	+	+	+	+	+	-	n/a	+	90
<i>Wedderkop, 1997</i>	+	+	+	n/a	+	+	+	+	+	-	n/a	+	90
<i>Tyrdal, 1998a</i>	+	+	-	n/a	-	+	+	+	-	-	n/a	-	50
<i>Tyrdal, 1998b</i>	+	+	-	n/a	-	+	+	+	-	-	n/a	-	50
<i>Tyrdal, 1998c</i>	+	+	-	n/a	-	+	+	+	-	-	n/a	-	50
<i>Seil, 1998</i>	+	+	+	n/a	+	+	+	-	+	-	-	+	72,5
<i>Tyrdal, 1999</i>	+	+	-	-	-	+	+	+	+	+	-	-	58
<i>Rise, 2001</i>	-	+	-	n/a	+	+	+	+	-	-	n/a	-	50
<i>Popovic, 2002</i>	+	+	-	+	+	+	+	+	+	-	n/a	-	72,5
<i>Langervoort, 2007</i>	+	-	+	n/a	-	+	+	+	-	-	+	+	63,5

(+) Positive; (-) Negative; n/a= not applicable. Total = Percentage of items scored as positive

DISCUSSION

The analysis of the results of the included studies in this review demonstrated that there are few studies in the literature about the syndrome handball goalie's elbow. Most of the studies talked about the epidemiology of this injury in amateur and professional players. Despite the low rates of this injury as compared with other ones, it affects the goalkeepers almost exclusively because of repetitive traumas when the goalkeepers realize their blocks.

The studies that approached the epidemiology of handball injuries demonstrated that elbow injuries are not common as injuries to other joints. In a prospective study (Seil et al., 1998) it was possible to note that elbow injuries were responsible for a small part of all overuse injuries during a season with professional and semi-professional players. The results of this study were similar to those of another study that evaluated handball players during the main tournaments (Langevoort, Myklebust, Dvorak, & Junge, 2007), whereas in one of these tournaments, no elbow injuries were reported.

Another study with professional players reported that elbow injuries represented only 7% of all injuries during a season, but they affected goalkeepers almost exclusively (Wedderkopp et al., 1997). Similar results were found by Tyrdal and Bahr (Tyrdal & Bahr, 1996), who reported that about 40% of goalkeepers reported pain in the elbow during the season, and 34% reported previous pain in the same

location. It is believed that the high injury rates in goalkeepers' elbows occurred because of sports movements during a game, in which the ball can reach high velocities at the moment it hits the goalkeepers' hands or forearms in extension, generating high impacts on the joint.

The injury mechanism of the syndrome 'handball goalie's elbow' was investigated by Tyrdal and Olsen (Tyrdal & Olsen, 1998), in an experimental study with cadaveric elbows fixed in a tridimensional, kinematic loading system. Progressive overloads were applied by bags filled with water, fixed to an eyelet screw through the ulna and distal radius with forearm supinated, inducing elbow hyperextension. The objective was to simulate the impact of the ball with the forearm. Joint laxity and increased carrying angle were found, as well as articular capsule lesions, partial rupture of collateral ligaments (medial and lateral), and articular cartilage of olecranon and humerus.

In another experimental study (Tyrdal & Olsen, 1998), with the same simulation model, but with the loads applied first in the radius and after in the distal ulna, similar results were found with respect to laxity and articular lesions, but without differences between groups related to the place where loads were applied. A third study (Tyrdal & Olsen, 1998) was also done with cadaveric elbows, but the loads were applied with the forearm in supination. An increased risk of injuries was found in the lateral region of the elbow, especially in the collateral lateral ligament. In this way, the mechanism of forced and repetitive hyperextension caused by ball impact in the distal region of the forearm, regardless of the place of impact, appears to be the injury mechanism of the syndrome 'handball goalie's elbow'.

The most common clinical manifestation of this syndrome is pain in the elbow region, and according to the studies (Popovic & Lemaire, 2002; Tyrdal & Bahr, 1996; Tyrdal & Finnanger, 1999), the pain is more frequent in the medial part of the elbow, but also affects the anterior, posterior, and lateral regions. Tyrdal and Finnanger (Tyrdal & Finnanger, 1999) in a prospective study, did not report reduced range of motion in extension of injured elbows as compared with uninjured elbows. This results differs from the study of Popovic and Lemaire (Popovic & Lemaire, 2002), which found significant differences in extension deficits of injured elbows as compared with the control elbows. This disagreement between studies can be explained by different study designs. The study that did not find significant differences did a comparison with the contralateral elbows (Tyrdal & Finnanger, 1999) whereas the other study (Popovic & Lemaire, 2002) the control group was compound by healthy people who were not used to practice some physical activity.

The studies exhibited differences in the importance of radiography in diagnosing handball goalie's elbow. Popovic and Lemaire (Popovic & Lemaire, 2002) demonstrated that osteophyte formation was found in 67% of injured goalkeepers.

In this study, an ultrasonographic evaluation was performed, and articular cartilage lesions were found, as well as intra-articular swelling and collateral lateral ligament lesions. Otherwise, Tyrdal and Finnanger (Tyrdal & Finnanger, 1999) did not find significant osseous lesions, and no correlation between symptoms and radiographic findings. In this way, radiography appears to be useful for detecting osseous alteration, but ultrasonography seems to be the more effective diagnostic exam, since overloads in elbow hyperextension can cause lesions on soft tissues especially.

Rise, Dhaenens and Tyrdal (Rise, Dhaenens, & Tyrdal, 2001), evaluated nerve structures involvement in handball goalkeepers with injured elbows, but the results did not demonstrated that neurological and neurophysiologic structures of ulnar and median nerves are not frequent in this syndrome.

CONCLUSION

The results of this review demonstrated that even with few studies about handball goalie's elbow, its prevalence among goalkeepers is high. The mechanism of injury involves repetitive trauma in elbow hyperextension, and this injury is characterized by pain in the medial region of the elbow, usually concerning soft tissue lesions. There are no studies about treatment and prevention of elbow injuries in goalkeepers, which makes it important to implement randomized clinical trials to evaluate interventions for treating and preventing the syndrome handball goalie's elbow.

REFERENCES

- Akgun, U., Karahan, M., Tiryaki, C., Erol, B., & Engebretsen, L. (2008). Direction of the load on the elbow of the ball blocking handball goalie. *Knee Surg Sports Traumatol Arthrosc*, 16(5), 522-530.
- Dirx, M., Bouter, L. M., & de Geus, G. H. (1992). Aetiology of handball injuries: a case--control study. *Br J Sports Med*, 26(3), 121-124.
- Downs, S. H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health*, 52(6), 377-384.
- Jobe, F. W., & Nuber, G. (1986). Throwing injuries of the elbow. *Clin Sports Med*, 5(4), 621-636.
- Johnston, J., Plancher, K. D., & Hawkins, R. J. (1996). Elbow injuries to the throwing athlete. *Clin Sports Med*, 15(2), 307-329.
- Langevoort, G., Myklebust, G., Dvorak, J., & Junge, A. (2007). Handball injuries during major international tournaments. *Scand J Med Sci Sports*, 17(4), 400-407.
- Nielsen, A. B., & Yde, J. (1988). An epidemiologic and traumatologic study of injuries in handball. *Int J Sports Med*, 9(5), 341-344.
- Popovic, N., & Lemaire, R. (2002). Hyperextension trauma to the elbow: radiological and ultrasonographic evaluation in handball goalkeepers. *Br J Sports Med*, 36(6), 452-456.
- Rise, I. R., Dhaenens, G., & Tyrdal, S. (2001). Is the ulnar nerve damaged in 'handball goalie's elbow'? *Scand J Med Sci Sports*, 11(4), 247-250.
- Seil, R., Rupp, S., Tempelhof, S., & Kohn, D. (1998). Sports injuries in team handball. A one-year prospective study of sixteen men's senior teams of a superior nonprofessional level. *Am J Sports Med*, 26(5), 681-687.
- Strand, T., Tvedte, R., Engebretsen, L., & Tegnander, A. (1990). Anterior cruciate ligament injuries in handball playing. Mechanisms and incidence of injuries. *Tidsskr Nor Laegeforen*, 110(17), 2222-2225.
- Tyrdal, S., & Bahr, R. (1996). High prevalence of elbow problems among goalkeepers in European team handball -- 'handball goalie's elbow'. *Scand J Med Sci Sports*, 6(5), 297-302.
- Tyrdal, S., & Finnanger, A. M. (1999a). Osseous manifestations of 'handball goalie's elbow'. *Scand J Med Sci Sports*, 9(2), 92-97.
- Tyrdal, S., & Olsen, B. S. (1998). Combined hyperextension and supination of the elbow joint induces lateral ligament lesions. An experimental study of the pathoanatomy and kinematics in elbow ligament injuries. *Knee Surg Sports Traumatol Arthrosc*, 6(1), 36-43.
- Tyrdal, S., & Olsen, B. S. (1998). Hyperextension of the elbow joint: pathoanatomy and kinematics of ligament injuries. *J Shoulder Elbow Surg*, 7(3), 272-283.

- Tyrdal, S., & Olsen, B. S. (1998). Hyperextension trauma to the elbow joint induced through the distal ulna or the distal radius: pathoanatomy and kinematics. An experimental study of the ligament injuries. *Scand J Med Sci Sports*, 8(3), 177-182.
- Wedderkopp, N., Kalsoft, M., Lundgaard, B., Rosendahl, M., & Froberg, K. (1997). Injuries in young female players in European team handball. *Scand J Med Sci Sports*, 7(6), 342-347.

Número de citas totales / Total references: 32 (100%)

Número de citas propias de la revista / Journal's own references: 0