ISSN: 0212-8799

172

Volumen 33(2)
Marzo - Abril 2016

Archivos de medicina del deporte

Órgano de expresión de la Sociedad Española de Medicina del Deporte

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Archivos de medicina del deporte

Revista de la Sociedad Española de Medicina del Deporte

Afiliada a la Federación Internacional de Medicina del Deporte, Sociedad Europea de Medicina del Deporte y Grupo Latino y Mediterráneo de Medicina del Deporte

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Publicidad
ESMON PUBLICIDAD
Tel. 93 2159034

Publicación bimestral
Un volumen por año

Depósito Legal
Pamplona. NA 123. 1984

ISSN
0212-8799

Soporte válido
Ref. SVR 389

Indexada en: EMBASE/Excerpta Medica, Índice Médico Español, Sport Information Resource Centre (SIRC), Índice Bibliográfico Español de Ciencias de la Salud (IBECS), y Índice SJR (SCImago Journal Rank).

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Volumen 33(2) - Núm 172. Marzo - Abril 2016 / *March - April 2016*

Summary / Sumario

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The "Quebrantahuesos" (breaks bones) and the sports-medical examinations

La Quebrantahuesos y los reconocimientos médico-deportivos

Pedro Manonelles Marqueta

Presidente de la Sociedad Española de Medicina del Deporte.
Director de la Cátedra Internacional de Medicina del Deporte de la UCAM.

Recently the organisation of one of the biggest open Spanish sports trials, and the largest cycling event, the "Quebrantahuesos" (QH) – breaks bones – took the decision to require a compulsory medical certificate in order to participate, just as in other countries such as France.

The Spanish Sports Medicine Society, upon request from the organisers, advised on the contents of the medical examination and offered medical centres where they could be performed.

From the very outset, it supported the QH organisation in this decision, and it has publically acknowledged this brave decision that initially had some negative consequences through the rejection and complaints of some participants.

Without a doubt, the competition will not suffer future detrimental effects, and the majority of participants understand that this measure has no other purpose than to protect the athletes' health, something that has been insistently requested for many years by the Sports Medicine Society. This editorial has arisen as a result of this issue: athletes and the obligation to undergo medical controls BEFORE participating in their sport. This comes on the back of a participant that bitterly complained to the organisation because in the examination that was performed on him, a problem was discovered that contraindicated participation in his sport. His reaction, instead of the logical and expected thanks to the doctor that discovered a significant pathology and furthermore thanks to the QH organisation for having initiated this pioneering measure, was to complain and threaten prosecution for preventing him from participating.

It seems very timely to refer to a well-known Spanish proverb "prevention is better than cure", to illustrate this sorry response.

Medicine, and in particular Sports Medicine, has the crucial aim of prevention. Undoubtedly is it much better to avoid the pathology than to have to treat it once it has appeared. This is especially relevant in the case of sudden death in athletes. This is why all possible efforts should be made to prevent sport-related problems, particularly if they are as serious as sudden death[1,2].

It should be highlighted that physical exercise is fundamentally a source of health and is considered that the greatest potential benefit of exercise is its capacity to preserve the functional capacity, freedom and independence of the subject[3]. Furthermore, it constitutes an excellent therapeutic tool for the majority of chronic illnesses, some of which are truly epidemic, such as obesity, hypertension and diabetes[4].

However, it should not be overlooked that despite its enormous beneficial effects, exercise has its risks, such as accidents[5], severe injury due to overloading[6,7], breakdown of chronic pathologies[8], sudden death and other cardiac events[9], and various medical problems related to physical activity in itself, such as dehydration, hyponatremia, acute fatigue, bronchoconstriction, and exercise-induced anaphylaxis, rhabdomyolysis, iron-deficiency anaemia, gastrointestinal disorders, problems related to extreme temperatures, immunological alterations, etc.

Cycle-tourism, except for error or omission, does not appear in the sports catalogue of the Spanish Cycling Federation, and is a physical sporting activity that combines sport with tourism, and does not have a competitive nature.

In Medicine, practising non-competitive sport is often recommended for people with some chronic pathology, to obtain the benefits from physical activity whilst avoiding high-intensity problems, but no doctor in their sound judgement would commit the recklessness of recommending cycle-tourism to these patients.

The QH, classified as cycle-tourism, just as any other cycle-tourism has connotations of the highest competitive level. The cycle-tourist

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will compete with the others, and on many occasions, which is worse, with him/herself, trying to finish it in increasingly quicker times, which converts this type of trial into a risky, even high-risk activity.

The QH covers 200 km of the Pyrenees in which cyclists ascend to ports (Portalet, Somport, Hoz and Marieblanc), the latter classed as special and which starts in a place called Escot "the port of agony". Completion takes between five and a half, and twelve hours.

Its difficult nature is obvious, and in addition, these trials and other similar ones, may have severe health consequences. The first, an immediate increased cardiovascular risk. The paradox of exercise: Exercise performed regularly and suitably reduces the risk of having cardiovascular diseases, but at the time the physical activity is being performed, the risk of suffering sudden death multiplies by two from the start of the physical or sporting activity up to more than 24 hours later[10].

It is not necessary to carry out an exhaustive and detailed analysis of the consequences of long-lasting activities on the body, but some of them are worth remembering.

Resistance sport increases the prevalence of auricular fibrillation[11]; it seems that this may increase cardiac damage, with remodelling and formation of fibrotic myocardial zones[12]; an overloading of the right cardiac cavities, transitorily reduces the right ventricular ejection fraction and raises cardiac biomarkers[13]; increases morbidity and long-term cardiac mortality[14].

Some 30-50% of participants in resistant sports experience gastrointestinal symptoms whilst practising the sport, such as nausea, vomiting, abdominal cramping, diarrhoea, and also the presence of blood in faeces[15].

Finally, the long-lasting effects of sport on the renal system are well known: acute renal injury and haematuria[16].

By no means is the prevalence of all these problems negligible, and their prevention and control require on-going medical attention, which starts with the first contact between the doctor and the athlete, via the required sports-medical examination. There is no doubt that the participants in the QH will ride bicycles that in many cases, cost a shameful amount of money, not to mention the additional costs of practising amateur cycling (accessories, clothes, trips, energy drinks, nutritional supplements, etc.). But it is somewhat exceptional for these, and other athletes, to include a sports-medical examination in their provisions, or a strength test, and it is not even worth mentioning sports-medical follow-up and supervision.

Reactions have emerged from the decision to enforce a compulsory certification by the organisers of large sporting events, just as with the QH, and it does not cease to amaze that some organisations, already with several sudden deaths recorded throughout their activity history, have opted to impose a voluntary or anonymous questionnaire before participation, with the aim of detecting the risk of cardiac incidents or sudden death.

In this European context, it is not acceptable to resort to self-completed health questionnaires. A medical study by qualified doctors is required before practising sports, fundamentally specialists in Sports Medicine. These self-questionnaires may have some sense, though this is highly doubtful, however, in such as in English-speaking social contexts, and even in these contexts they dare to question it[17].

In our context, all the sports-medical organisations consider the performing of medical examinations prior to sporting participation to be essential, which should include basic elements such as a resting electrocardiogram[1,2,18-20], a model that was taken on by the former health protection committee of the Superior Sports Council, and which acts as a guideline for actions that are developed in Spain in this field[21].

The decision made by the QH organisation to require a compulsory presentation of an aptitude certification is not just extraordinarily important, and something for which they deserve recognition, but it also marks the beginning of a standardisation of this measure across all Spanish sport. We hope that sports organisers will be sensitive to this need and accept the challenge and responsibility of implementing measures that have no other purpose than achieving a healthy sporting practice for all participants.

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Comparison between non-exhaustive critical velocity estimated by heart rate with exhaustive critical velocity and heart rate variability threshold

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Received: 17.04.2015
Accepted: 20.07.2015

Summary

The aim of this study was to compare the critical velocity determined by a non-exhaustive test (CV_{NE}) using heart rate (HR) as physiological variable with the exhaustive critical velocity (CV) and the heart rate variability threshold (HRVT). Twelve male subjects (20.1 ± 1.6 years; 73.4 ± 10.3 kg; 1.76 ± 0.06 m) physically active took part of this study and performed an incremental test to determination the peak velocity and HRVT, three constant-load exhaustive tests to CV estimates and three non-exhaustive tests with two bouts of three minutes to CV_{NE} determination. The percentages used to CV estimates were of 97%, 111% and 130% of peak velocity from incremental test and to CV_{NE} were used of 72%, 92% and 110% of peak velocity. The incremental test was also important to determine the HRVT. The difference between CV_{NE} vs HRVT (2.61 ± 12.84 km.h^{-1} vs 7.92 ± 1.16 km.h^{-1}) and the CV_{NE} vs CV (2.61 ± 12.84 km.h^{-1} vs 12.20 ± 1.38 km.h^{-1}; $p > 0.05$) was not statistically significative, but a significant difference was observed between the HRVT and CV (7.92 ± 1.16 km.h^{-1} vs 12.20 ± 1.38 km.h^{-1}) ($p < 0.01$). The CV_{NE} demonstrated low agreement and weak correlation with HRVT (bias ± limits of agreement = -5.31 ± 25.09 km.h^{-1}; r = 0.08) and CV (bias ± limits of agreement = -9.59 ± 25.94 km.h^{-1}; r = -0.23). Thus, the CV_{NE} estimated by HR is not a valid parameter to evaluation of metabolic transition and to prescribe aerobic exercise.

Key words:
Non-exhaustive method. Heart rate. Exhaustive test.

Comparación entre velocidad crítica no exhaustiva estimada por la frecuencia cardíaca con velocidad crítica exhaustiva y el umbral de la variabilidad de la frecuencia cardíaca

Resumen

El objetivo de este estudio fue comparar a velocidad crítica determinada por un test no exhaustivo (CV_{NE}) utilizando como variable fisiológica la frecuencia cardíaca (HR) con velocidad crítica exhaustiva (CV) y el umbral de la variabilidad de la frecuencia cardíaca (HRVT). Veinte sujetos hombres (20,1 ± 1,6 años; 73,4 ± 10,3 kg; 1,76 ± 0,06 m) físicamente activos participaron en el estudio y realizaron un test incremental para determinar la velocidad pico y HRVT, tres exhaustivos testes de carga constante para estimar a CV y tres testes no exhaustivos con dos episodios de tres minutos para determinar la CV_{NE}. Los porcentajes utilizados para estimar a CV fueron 97%, 111% y 130% de la velocidad pico del test incremental y en CV_{NE} fueron usados 72%, 92% y 110% de la velocidad pico. El test incremental también era importante para determinar la HRVT. La diferencia entre la CV_{NE} vs HRVT (2,61 ± 12,84 km.h^{-1} vs 7,92 ± 1,16 km.h^{-1}) y el CV_{NE} vs CV (2,61 ± 12,84 km.h^{-1} vs 12,20 ± 1,38 km.h^{-1}; $p > 0,05$) no fue estadísticamente significativa, pero él se observaron diferencias significativas entre el HRVT y la CV (7,92 ± 1,16 km.h^{-1} vs 12,20 ± 1,38 km.h^{-1}) ($p < 0,01$). El CV_{NE} demostró menor concordancia y correlación con HRVT (sesgo ± límites de acuerdo = -5,31 ± 25,09 km.h^{-1}; r = 0,08) y CV (sesgo ± límites de acuerdo = -9,59 ± 25,94 km.h^{-1}; r = -0,23). Por lo tanto, la CV_{NE} estimado por HR no es un parámetro válido para la evaluación de la transición metabólica y prescribir ejercicio aeróbico.

Palabras clave:
Método no exhaustivo. Frecuencia cardíaca. Test exhaustivo.

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Introduction

There are several protocols to evaluate aerobic fitness in athletes, such as ventilatory threshold, lactate threshold and maximal lactate steady state (MLSS). However, their application becomes infeasible to be used routinely, due the expensive material and/or blood collection. Other protocol to evaluation of aerobic fitness without expensive materials is the critical velocity (CV). CV is a non-invasive parameter that can be estimated by mathematical models between velocity and time to exhaustion relationship[1-3].

Due the exhaustive characteristics of CV model, Chassain[4] proposed a method where the critical velocity can be determined by a non-exhaustive test (CV_{NE}). The CV_{NE} is a simple method that facilitates the evaluation mainly for frail and elderly people, because reduces the risks involved. Based on the analysis of the deltas of heart rate (HR) or blood lactate concentration ([La]) after double efforts, CV_{NE} is determined from a linear regression at intensity in which the delta of physiological variable is null.

According to Sid-Ali *et al*.[5] study, CV presented a strong correlation with the CV_{NE} using the [La] as physiology variable. Notwithstanding, Rosi *et al*.[6] showed that the value CV_{NE} estimated by HR was lower than MLSS. Therefore, it is not clear about the validity and if the CV_{NE} estimated by heart rate coincides with the first or second metabolic transition.

A way to identify the first metabolic transition is the heart rate variability threshold (HRVT). Karapetian *et al*.[7] showed that HRVT was not different and good correlated with first lactate threshold and ventilatory threshold. Thus, the aim of this study was to know if CV_{NE} predicted by HR could be considered similar to CV and/or HRVT. This information is important to better knowledge about the CV_{NE} physiological significance and its validity.

Material and methods

Subjects

Twelve male subjects (20.1 ± 1.6 years; 73.4 ± 10.3 kg; 1.76 ± 0.06 m) physically active took part of this study. The sample size was calculated by G*Power software (v.3.1.7) assuming $\alpha = 0.05$ and $\beta = 0.20$ based on a Rossi *et al*.[6] study. The subjects were considered physically active according to American College of Sports Medicine (ACSM)[8], which considers: to accumulate at least 30 minutes of moderate physical activity on five days a week or 20 minutes of vigorous physical activity on three days a week. A questionnaire was filled with the physical activities performed, period and times per week to guarantee these criteria. All participants were aware about the procedures of the experiment, and signed an informed consent previously approved by the local Ethics Committee in Human Research. In addition, the participants were instructed to not ingest alcohol and caffeinated beverages 24 hours preceding each test.

Experimental design

The procedures were performed at the same time of the day and consisted of an incremental test to determine the HRVT and the peak velocity, three tests with double submaximal efforts to estimate the CV_{NE}, and finally, three maximal tests to estimate the CV. Each test was performed on different days with at least 24 hours of interval between the tests.

Incremental test and HRVT determination

The participants underwent a progressive treadmill test (Inbramed Millennium, model ATL, Porto Alegre) to determine the peak velocity and the HRVT. The test started at 5 $km.h^{-1}$ with increments of 1 $km.h^{-1}$ every three minutes and constant slope of 1% until the voluntary exhaustion.

During the incremental test and all subsequent tests, the subjects used a portable heart rate monitor (Polar RS800, Kempele) fastened around the chest for continuous HR recordings. The RR were filtered automatically and visually examined to remove missing or premature beats. RR intervals were interpreted as premature beats when deviated from the previous qualified interval > 30%[9]. For the HRVT determination, root mean square differences of successive RR intervals (RMSSD) of the last 2 min of rest and each stage were analyzed plotting graphically against work rate. Then, a visual interpretation was made to locate the point at which there was no further decline in HRV, thereby indicating vagal withdrawal. Thus, this HRV deflection point was defined as the HRVT[7]. Based on the above criteria, two experienced researchers independently determined the HRVT. When there was a disagreement between them, a third experienced investigator was requested to HRVT determination. In all situations there was an agreement with at least two evaluators.

Critical Velocity determined by non-exhaustive tests

Each test consisted from two bouts of three minutes separated by a rest period of one and half minutes, which HR was continuously monitored[4]. The percentages of 72%, 92% and 110% of peak velocity were used to predict the CV_{NE}. The delta HR (ΔHR) value was calculated subtracting HR at the end of the second with HR at the end of the first bout. A linear regression was plotted with the values of ΔHR obtained in each load, permitting the determination of the ΔHR theoretically null. Thus, the value of CV_{NE} was considered as the Y-intercept of this linear interpolation (Figure 1).

Critical Velocity determined by exhaustive tests

The participants underwent three constant load tests to CV estimates at 97%, 111% and 130% of peak velocity and in which induced the individuals to exhaustion between 2-15 min. The CV was determined for all participants from the hyperbolic model by nonlinear regression between speed and time to exhaustion, where:

Time to exhaustion = anaerobic running capacity / (CV- speed)

The asymptote of the regression velocity-time was defined as CV and the curvature degree of the hyperbola was the anaerobic running capacity.

Statistical analyses

The data are presented as mean ± standard deviation. The Gaussian distribution was observed by Kolmogorov-Smirnov test. ANOVA

Figure 1. Linear regression between velocity and the difference of HR between the double efforts (ΔHR) of a subject.

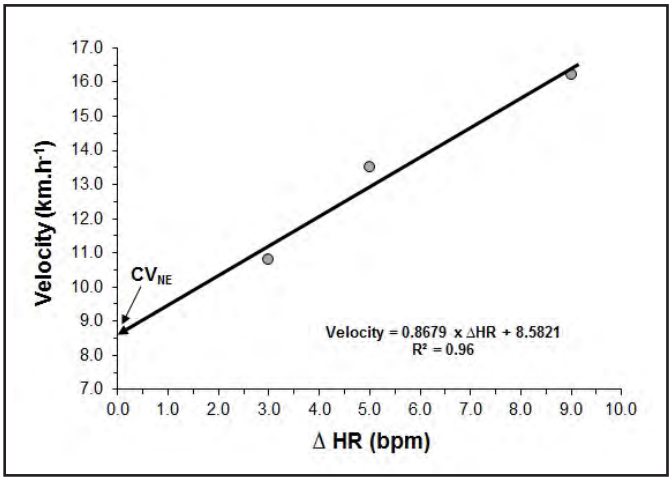
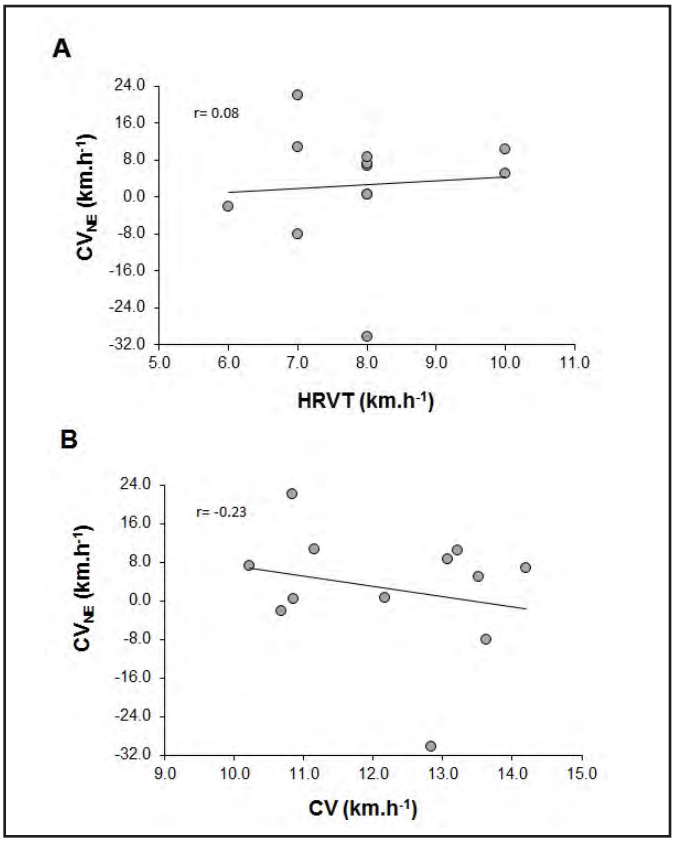


Figure 2. Relationships between critical velocity determined by a non-exhaustive test (CV_{NE}) with HRVT (A) and CV (B).



for repeated measures was used to compare the CV, HRVT and CV_{NE} velocity. The sphericity was observed by Mauchly's test followed by Greenhouse-Geisser. Differences were identified by Bonferroni correction. Moreover, the relation between the aerobic variables was verified through Pearson correlation, and the agreement by Bland-Altman plot. Data were considered statistically significant when $p < 0.05$.

Table 1. Mean and standard deviation of velocities corresponding the three intensities from predictive trial to CV_{NE} and CV estimates.

	CV_{NE}		
Percentage of peak power	72%	92%	110%
Mean ± SD (km.h^{-1})	9.78 ± 1.02	12.18 ± 1.22	14.60 ± 1.48
	CV		
Percentage of peak power	97%	111%	130%
Mean ± SD (km.h^{-1})	13.33 ± 1.29	15.48 ± 1.68	17.71 ± 1.75

Table 2. Mean and standard deviation values of CV_{NE}, HRVT and CV.

	CV_{NE} (km.h^{-1})	HRVT (km.h^{-1})	CV (km.h^{-1})
Mean	2.61	7.92*	12.20
SD	12.84	1.16	1.38

*Significant different from CV ($p < 0.001$).

Results

The mean the peak velocity during the incremental test was 13.08 ± 1.51 km.h^{-1}. The velocities from the predictive trials to CV_{NE} and CV estimates are presented in Table 1.

The CV_{NE} was not significant different when compared with HRVT and CV ($p > 0.05$). However, there was difference between HRVT and CV (Table 2). Additionally, weak correlation was observed between CV_{NE} with HRVT and CV (Figure 2). The bias ± limits of agreement between CV_{NE} and HRVT was -5.31 ± 25.09 km.h^{-1} and between CV_{NE} and CV was -9.59 ± 25.94 km.h^{-1}. The value the anaerobic running capacity was 735.45 ± 182.53 m.

Discussion

This study wanted to compare different methods that indicate the aerobic capacity. The main results of this study were that the CV_{NE} was not statistically different of HRVT and CV. Furthermore, CV_{NE} showed weak correlation and low agreement with both HRVT and CV.

According to the physiological response during the exercise, it is observed three different domains of effort[10]. The moderate domain is laid below the first metabolic threshold[11]. It comprises the intensities that can be sustained without inducing significant increase of [La] and there is a monoexponential increase of VO_2 during the approximately three initial minutes, reaching a steady state thereafter. The intense domain corresponds the intensities in which there is a late stabilization from VO_2 and [La] with the upper limit the second metabolic transition[11]. Above this intensity is called severe domain, in which the physiological variables increase until the exhaustion[11].

The HRVT corresponds the transition between moderate to intense domains and the CV the transition between intense to severe domains. Some studies have demonstrated that both methods are validated for aerobic fitness evaluation[1,7]. Our results showed that the CV_{NE} was not different of HRVT and CV. It probably occurred because the high variability of CV_{NE}, that can be observed by standard deviation, with three subjects with negative estimates. Furthermore, the correlations and agreement of CV_{NE} with HRVT and CV were low. Sid-Ali *et al*.[5] found different results, which the CV_{NE} (17.31 ± 1.85 km.h^{-1}) was not different in relation to CV (17.32 ± 1.11 km.h^{-1}), with a strong correlation (r = 0.97). However, the study by Sid-Ali *et al*.[5], the physiological variable used to CV_{NE} estimates was the [La], and in our study the physiological variable used was the HR. Notwithstanding, in Rosi *et al*.[6] study, it was observed that CV_{NE} estimated by [La] and HR was significantly lower than MLSS. Additionally, the correlations of CV_{NE} estimated by [La] and HR with MLSS were weak and not significant (r = 0.36, r = -0.12; respectively). Thereby, considering the Rosi *et al*.[6] and our results, it indicates that CV_{NE} is not a good tool to aerobic parameters estimates and to prescribe the velocity of training.

In comparison of HRVT with CV, it was observed that the HRVT was lower than CV. It occurred because the HRVT corresponds to the first metabolic transition, whereas CV is equivalent to the boundaries of second metabolic transition. The HRVT is an indirect method, noninvasive and of easy application for identification aerobic threshold speeds[7]. Karapetian *et al*.[7] presented similar VO_2 at HRVT and at ventilatory threshold. Dourado *et al*.[12] corroborate these results, in which the speed at ventilatory threshold (5.04 ± 1.00 km.h^{-1}) was not different from HRVT (5.10 ± 1.04 km.h^{-1}) and presented strong correlation (r= 0.89).

The other metabolic transition indicator analyzed in our study was CV. There is some contradictory finding about CV, in which some authors showed that CV is the upper limit of heavy domain and corresponds to anaerobic threshold and MLSS[13,14]. However, other studies have showed that CV is considered the lower limit of severe domain, considering the initial intensity that there is not metabolic steady state[15,16]. The critical velocity model was previously applied in different situation, such as running[1], cycling[13,17] and swimming[3], presenting high correlation with performance[3,17]. Thus, the CV is a reliable parameter for evaluation as well as for aerobic prescription.

In our study, the CV was similar to Cruz *et al*.[18] study (13.32 ± 2.30 km.h^{-1}) but lower than compared to those obtained by Denadai *et al*.[19] (14.4 ± 1.10 km.h^{-1}), Sid-Ali *et al*.[5] (17.31 ± 1.11 km.h^{-1}). It is probably occurred due the characteristics of population, in which in our study was used moderate physical active subjects or recreational athletes and other authors used soccer players[19] and runners[5].

The main limitation of the present study was not to evaluate the physiological responses (e.g. lactate and oxygen uptake) at the CV_{NE}, HRVT and CV. Furthermore, probably the CV_{NE} estimates is protocol dependent, and the selection of intensities can modify the HR behavior. However, more studies are necessary to verify the influence of different intensities combinations to predict CV_{NE}. Thus, it can be concluded that CV_{NE} estimated by HR cannot be considered valid and a good tool to verify the aerobic fitness, presenting a weak correlation and very low agreement with HRVT and CV. Thereby, the CV_{NE} does not coincide nor with the first neither with second metabolic transition.

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Comparative study between symmetrical and asymmetrical sports by static structural analysis in adolescent athletes

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Received: 18.03.2015
Accepted: 22.07.2015

Summary

In pre-participative sports medical examinations, the analysis of the anatomical structures that are not directly related to the sport in question, is usually more superficial. A more detailed assessment of the locomotive system may reveal the existence of certain anomalies, which may occasionally go unnoticed.

The aim of this study is to describe the prevalence of structural disorders of the locomotive system among elite-level athletes from the Community of Madrid. To establish the relationship between alterations and practising symmetrical or asymmetrical sports.

Descriptive cross-sectional study Level of evidence II-III.

Our study sample includes athletes that are members of the Community of Madrid Sports Technification Plan. 102 athletes, 66 males and 36 females aged between 12 and 19 years. One control group comprises swimming athletes, a sport considered to be symmetrical, and the second group comprises athletes practising sports considered to be asymmetrical: fencing and badminton. The athletes were examined following a blind method by three different specialists using the same protocol.

Hypothesis contrasting has been used for qualitative variables, with a 95% confidence level ($p<0.05$).

Ninety-six athletes (94.1%) displayed some kind of structural and/or postural alteration in the pre-participative sports medical examinations. No significant correlation was found ($p<0.05$) between the different sports on alterations to the spine, knees, extremities and footprint, regardless of whether they were symmetrical or asymmetrical ($p<0.05$).

Conclusions: Our study revealed a high prevalence of structural variation in high-level adolescent athletes. No relationship was found between practising an asymmetrical sport and the prevalence of scoliosis or other muscular-skeletal alterations.

Key words:
Scoliosis. Sports medicine. Medical history taking. Musculoskeletal abnormalities. Foot deformities.

Estudio comparativo entre deportes simétricos y asimétricos mediante análisis estructural estático en deportistas adolescentes

Resumen

En los exámenes médicos preparticipación deportiva, el análisis de las estructuras anatómicas que no están directamente relacionadas con el deporte en cuestión, suele ser más superficial. Un examen más detallado del aparato locomotor podría revelar la existencia de ciertas anomalías que, en ocasiones pueden pasar desapercibidas.

El objetivo de este estudio es describir la prevalencia de trastornos estructurales del aparato locomotor en una población de deportistas adolescentes de élite de la Comunidad de Madrid. Establecer la relación de alteraciones con la práctica de deportes simétricos o asimétricos.

Estudio transversal descriptivo. Nivel de evidencia II-III.

Nuestra población de estudio incluye deportistas pertenecientes al plan de tecnificación de la Comunidad de Madrid: 102 deportistas, 66 hombres y 36 mujeres con edades comprendidas entre 12 y 19 años. Un grupo control está compuesto por deportistas de natación, deporte considerado simétrico y el segundo grupo por deportistas practicantes de deportes considerados asimétricos: esgrima y bádminton. Los deportistas fueron examinados siguiendo un método cegado por tres diferentes especialistas que utilizaron el mismo protocolo.

Se ha empleado el contraste de hipótesis para variables cualitativas, con un nivel de confianza del 95% ($p<0,05$).

Noventa y seis deportistas (94,1%) presentaron algún tipo de alteración estructural y /o postural en los exámenes médicos preparticipación deportiva. No encontramos correlación significativa ($p<0,05$) entre los diferentes deportes en las alteraciones en la columna vertebral, las rodillas, las extremidades y la huella plantar, independientemente fueran simétricos o asimétricos ($p<0,05$).

Conclusiones: Nuestro estudio muestra una alta prevalencia de variaciones estructurales en los adolescentes que practican deporte de alto nivel. No encontramos relación entre practicar un deporte asimétrico y la prevalencia de escoliosis u otra alteración músculo-esquelética.

Palabras clave:
Escoliosis. Medicina del deporte. Exploración clínica. Alteraciones musculoesqueléticas. Deformidades del pie.

This work was made possible by the research grants from the Madrid Sports Medicine Centre.

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Introduction

The main aims of a pre-participation sports medical examination include, on the one hand, the ruling out of any pathology that may condition or impede incorporation into a specific sport, and on the other hand, an assessment of physical capacity at that specific time. This information allows us to establish a customised training plan, that is adapted to the physical and technical characteristics of the athlete, and appropriate for the needs of the sport practised[1]. In the majority of cases, the analysis of the anatomical structures that are not directly related to the specific sport is more superficial and on many occasions certain structural variations can be observed that may condition performance or increase the injury rate[2]. On the one hand, high intensity sport undertaken during periods of growth and adolescence may contribute to muscular-skeletal asymmetries[3], and on the other hand, poor joint alignment may condition the presence of injuries[4-8] and constitute an osteoarthritis risk factor[9,10]. A more detailed assessment of the locomotive system may reveal the existence of certain alterations, which upon correction may improve both aspects. Its detection may be more significant during the accelerated growth period, during adolescence (10-11 to 17 years in girls and 12 to 19 years in boys)[11]. During this period, the muscular-skeletal system may be particularly sensitive to traction forces that are performed[12-16]. Secondly, traditionally asymmetrical sports have been discouraged among young athletes that present some structural alteration to the spine in the frontal plane, as it is considered that these sports worsen these alterations by overloading one side of the body[15,17-19]. The aim of our study is to describe the prevalence of structural alterations of the elite athlete Madrid population aged between 11 and 19 years, and to study a possible relationship with the practice of an asymmetrical sport with the practice of an asymmetrical sport.

Study design: cross-cutting descriptive study. Level of evidence II-III.

Material and method

The study sample comprised 102 athletes, 66 males and 36 females aged between 12 and 19 years (average 15.58±2.14), from three sports: swimming, fencing and badminton. The control group was composed of athletes that practised swimming, considered to be a symmetrical sport. The choice of asymmetrical sports was carried out randomly from all the sports considered asymmetrical with athletes that had been technified by the Community of Madrid (handball, tennis, throwing, fencing and badminton) (Flow Chart. Figure 1). All the athletes were part of the Community of Madrid (CM) Sports Technification Plan (Spain), had over three years practice in the specific sport, and performed a minimum of two hours training a day. They were referred to the CM Sports Medicine Centre by the different sporting federations over the past three years for sporting-medical follow-up. Table 1 contains the total number of athletes classified by sex and by sport, with their anthropometric characteristics.

All the subjects and their legal guardians were informed about the nature and characteristics of the study, and prior to the start they signed the informed consent form, in accordance with the principles in the Helsinki declaration for research on humans[20].

Figure 1. Flow Chart.

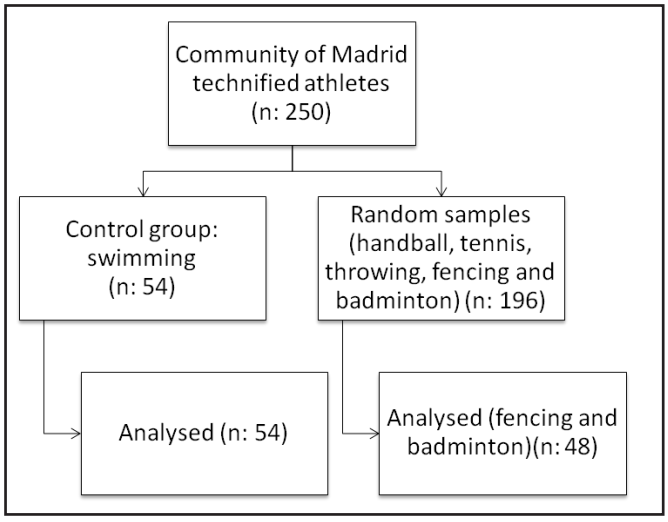

Table 1. Distribution of the sample by sex.

	n	Age	Height	Weight
Females				
Swimming	23	14 ± 1.9	1.64 ± 0.07	54.8 ± 8.46
Badminton	7	16 ± 1.29	1.63 ± 0.02	57.5 ± 3.60
Fencing	6	18.5 ± 0.83	1.60 ± 0.05	56.4 ± 4.41
Total	36	15.19 ± 2.33	1.64 ± 0.06	55.6 ± 7.17
Males				
Swimming	31	14.5 ± 1.7	1.69 ± 0.09	58.3 ± 11.5
Badminton	16	16.6 ± 1.8	1.70 ± 0.15	65.5 ± 10.61
Fencing	19	17.15 ± 1.2	1.75 ± 0.06	59.4 ± 7.25
Total	66	15.78 ± 2.0	1.71 ± 0.10	60.7 ± 11.35

Each athlete was assessed by three sports medicine specialist doctors, using a blind method, following the same work methodology as with previously consensual works.

Protocol

The static structural study included the anterior, lateral and posterior inspection of the spine, thorax and lower extremities facing a clear millimetre ruler, including a plumb line test and an anterior bending test, with the aim of assessing various postural or structural alterations of the spine (scoliosis, lumbar hyperlordosis and hyperkyphosis). The foot print was assessed using a podoscope, to establish the print type (cavus or flat). Measurement of the patello-femoral angle with a goniometer. Measurements of the intermalleolar and intercondylea distances and the knee extension angle, with the aim of assessing the *genu varo*, *valgo* or *recurvatum*. Measurement of the length of the lower extremities from the anterior-superior iliac spine to the medial malleolus, to assess possible dissymmetries. Normal limits were established for the different alterations found. It was considered *genu valgo* when the patello-femoral angle >6º and the intermalleolar distance >8 cm, *genu varo* if the intercondylea distance >3 cm and the patello-femoral angle >3º[21-23].

Genu recurvatum if the knee-joint angle was greater than 180º[24]. The assessment of flat and cavus foot was carried out by non-quantitative visual inspection[8,25,26]. Assessment of the lumbar curve was carried out by establishing the distance between the plumb line and the furthest point away from it, with the values classed as hyperlordosis if greater than 35 mm, normal if between 20 and 35 mm, and hypolordosis if less than 20 mm[27]. The kyphotic curve was assessed by measuring the distance of the plumb line to the spinous process of C7, with hyperkyphosis considered to be when the distance was greater than 30 mm and a flat dorsum lower than 15 mm[28]. The study of the frontal plane spinal deviations was carried out using the anterior bending test (Adam's test) and the measurements of the angles using a Scoliometer[29,30].

The total percentages of the structural deviations found in the feet, spine, and lower extremities, were established using the total study sample, while the analysis of each specific alteration was carried out on the partial sample group that presented some kind of anomaly in this area of the body.

The total rate of structural deviations among the athletes was compared to that obtained in each individual sport, with the aim of establishing a possible relationship between practising a specific sport and the development of some kind of structural alteration. Likewise, the cases were studied by sex and by sport, assessing the possible significant differences in each group. For the statistical handling of the data, SPSS 20 computing packages were used. EpiInfo 6.0 and Statgrafics version 6.0. Hypothesis contrasting has been used for qualitative variables, with a 95% confidence level ($p < 0.05$).

Results

In ninety-six athletes (94.1%), some kind of poor structural and/or postural alignment was detected during the examination. The examiners found that only six athletes (5.9%) did not present any alterations. Furthermore, no athlete presented secondary scoliosis (congenital, neurological, metabolic, etc.) according to the criteria from the *Scoliosis Research Society* (SRS)[31].

The alterations discovered were the following (Tables 2 and 3):

- *Feet:* In sixty-one athletes, alterations were detected in the footprint (59.8%). Six of them presented Grade I flat foot (5.9%), three had Grade II flat foot (2.9%), and two had Grade III flat foot (2%). Nineteen presented pre-cavus foot (18.6%), thirteen had Grade I cavus foot (12.7%), and eighteen had Grade II cavus foot (17.6%). Forty-one athletes did not present alterations in the footprint (40.2%).
- *Lower extremities: Knee:* alterations were discovered in the joints of twenty-seven athletes (26.5%). Nine with valgus knee (8.8%), six with varus knee (5.9%), and twelve with *genu recurvatum* (11.8%). Seventy-five athletes did not display any alterations in the knee joints (73.5%).
- *Dissymmetry:* Twenty-one athletes displayed leg-length difference (20.6%). Thirteen with Left Lower Limb (LLL) predominance (12.7%) and eight with Right Lower Limb (RLL) predominance (7.8%). Eighty-one athletes did not present dysmetria in lower-limbs (79.4%).

Table 2. Structural deviation by sport.

Sport	Spine	Knees	Dissymmetries	Footprint
Badminton	6 (18.2%)	4 (14.8%)	2 (9.5%)	16 (26.2%)
Fencing	10 (30.3%)	5 (18.5%)	6 (28.6%)	13 (21.3%)
Swimming	17 (51.5%)	18 (66.7%)	13 (61.9%)	32 (52.5%)
Total	33 (100%)	27 (100%)	21 (100%)	61 (100%)

Table 3. Structural deviations by symmetrical and asymmetrical sports.

Sport	Spine	Knees	Dissymmetries	Footprint
Asymmetric	16 (48.5%)	9 (33.3%)	8 (38.1%)	29 (47.5%)
Symmetrical	17 (51.5%)	18 (66.7%)	13 (61.9%)	32 (52.5%)
Total	33 (100%)	27(100%)	21(100%)	61(100%)

- *Spine:* Thirty-three athletes (32.4%) presented static postural and/or structural alterations in an anterior and posterior vision of the spine, the anterior bending test and measurement with the Scoliometer. Alterations to the frontal plane were: ten cases of right dorsal scoliosis (9.8%), eleven left dorsal scoliosis (10.8%), one right lumbar scoliosis (1%), one left lumbar scoliosis (1%) and two double thoracic curve (2%). The alterations found in the sagittal plane were: five athletes with hyperlordosis (4.9%), one hyperkyphosis (1%), and two cases of hyperkyphosis with hyperlordosis (2%). Seventy-nine athletes did not display any postural or structural alterations to the spine (67.6%). All the athletes had slight structural alterations to the spine[32,33], none of them presented scoliotic curves above 10º following measurement with the Scoliometer. In two athletes (8%), a left-thoracic curve was measured of over 15º, assessed with a radiographic study, presenting curves of 18º and 20º Coob for both cases. No significant correlation was found ($p < 0.05$) between the different sports and alterations to the spine, knees, extremities and footprint.

Discussion

An athlete's lack of progress and a higher injury rate may be associated with structural or postural alterations that have not diagnosed or corrected early. A detailed and thorough structural study of the muscular-skeletal system identifies some of these alterations, which a routine sports medical examination may not assess. In some cases it is necessary to carry out complementary tests such as radiological studies in order to assess them more thoroughly and appropriately[34].

In this study, structural variations were found in 94.1% of the study sample, similar results to a previous study in fencing[35]. Despite the majority of these deviations being considered variations of normality, given that in many cases there is no consensual agreement with strict clinical or radiological criteria for the definition of a flat foot[36]. Regarding lower limb dissymmetry, we consider it to be a difference of 5mm or more between the limbs, though the majority of authors do not consi-

der dissymmetries lower than one centimetre to constitute structural anomalies, nor do we know the long-term evolution in adolescents that practise high-intensity sport, nor the possible consequences on injury rates. However, the high deviation rate found implies that a more thorough study of the muscular-skeletal system would reveal anomalies, that despite not appearing in a superficial examination, may condition performance and increase the injury rate, which is why is would be advisable to carry out long-term prospective studies. In any case, it would be recommendable to diagnose and try to correct these issues early, before the athlete reaches high-level competition. The discoveries made, as well a previous studies[35,37], lead us to consider the need to carry out a more exhaustive structural study of children that are starting their sporting careers.

The practice of sports in general does not appear to be associated with the appearance or evolution of scoliosis[38], though there are studies that suggest that practising an elite sport from an early age presents a higher prevalence of scoliosis[17,39-42]. This information coincides with that found in this study, in which the percentage of structural alterations of the spine among the sample studies was 32.4%. This figure is higher than the general population[43-45] and is higher than the percentage found in the previous study[37]. In this study, no scoliotic curves were found of over 20º, which may suggest that scoliosis of over 20º may be a limiting factor for practising sports at an elite level. However, the structural alterations found require the establishment of special attention by medical staff that perform medical examinations on children and adolescents, in particular among high-level athletes. Furthermore, it is important to highlight the differential diagnosis of a structural scoliosis, in particular for left thoracic curves[46]. In these cases, a complementary radiographic or topographic study is recommended, given that the examination may not be enough to assess these curves[34].

Classically, a higher incidence of scoliosis and asymmetrical muscular-skeletal adaptations has been related to athletes that mainly use one part of their bodies, considered asymmetrical[15,17-19], though other authors have not found these same results from fencing[47]. In this study, we did not find a relationship between structural alterations and the practise of a specific sport, whether symmetrical or asymmetrical.

Till now, no strong scientific evidence has been produced proving that a compensatory exercise plan may prevent the progress of a scoliosis[48], likewise, the practise of an asymmetrical sport, as shown in this study, does not seem to increase the risk of scoliosis, even if carried out to a competitive level.

All the athletes examined filled out a questionnaire about the type of physical exercise performed, and all of them carried out compensatory exercises on the non-dominant side as part of training. It is not known if this may be the reason for not finding differences between symmetrical and asymmetrical sports. However, the results obtained lead us to insist upon the need to carry out compensatory exercises as part of training.

Study limitations: this work is a pilot study with an elite-level adolescent sporting population from a specific region in Spain. We therefore recommend studies with large study groups. We have not used a control group from the general public, which may be considered a study limitation. However, the aim of this study was to describe the alterations in high-level athletes and to alert them of the possible consequences of them on performance.

Conclusions

This study reveals a high prevalence of structural variations among adolescents that practise high-level sport, which is why the importance of a thorough physical examination in pre-participative sports examinations should be highlighted. No relationship was found between practising an asymmetrical sport and the prevalence of scoliosis or other muscular-skeletal alterations.

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Rupture of the distal biceps tendon. Why is the incidence rate increasing? When should it be repaired?

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Received: 10.11.2014
Accepted: 23.07.2015

Summary

Introduction and objectives: The breaking of the distal biceps tendon is rare and represents only 3% of all breakings of this tendon. However, for the last decade this percentage has increased up to 10%. They are characteristic of middle-aged men with a predominance of the dominant arm. Local risk factor (high functional demand) and systemic ones (smoking, dyslipidemia, steroids, analogies, obesity) are associated with this pathology. Our goal is to analyze the risk factors which are associated with this condition and evaluate the results after surgical repair of the tendon.

Materials and methods: Retrospective study of 13 patients diagnosed with distal biceps tendon breaking in our hospital from May 2012 to January 2014. All patients were treated surgically with anatomic reattachment single trak (69,23 % with Endobutton's technique and 30,77 % remembering using harpoons). There have been assessed factors such us potential risk factors, joint mobility, early and late complications and the patient's degree of satisfaction (scale Karunakar). Their clinical follow-up was carried out for at least 6 months after the surgery.

Result: All patients were male, with an average age of 42,69 years, the 92,3 % were in the dominant arm, 76,92 % of the patients usually exercised the biceps while training and 53,84 % were taking medication for dyslipidemia. The results obtained after the treatment were excellent, shawing that all patients were satisfied with it.

Conclusion: The risk factors that are known so far such us smoking, dyslipidemia, steroids, anabolics and obesity do not justify the increase in the currents incidence rate. Regular exercise involving the biceps brachial muscle in patients with risk factors increases the probability of breaking the distal biceps tendon and anatomic reattachment anterior approach is a correct treatment option.

Key words:
Break. Biceps. Factors.

Rotura distal del tendón de la porción larga del bíceps braquial. ¿Por qué está aumentado su incidencia? ¿Cuándo se debe reparar?

Resumen

Introducción y objetivos: La rotura del tendón distal del bíceps braquial es poco frecuente y representa sólo el 3% de todas las roturas de este tendón, aunque en la última década ha aumentado hasta un 10%. Son características en varones de edad media con predominio del brazo dominante. Se asocian factores de riesgo locales (alta demanda funcional) y sistémicos (tabaco, dislipemia, corticoides, anabolizantes, obesidad). Nuestro objetivo es analizar los factores de riesgos asociados a esta patología y evaluar los resultados tras la reparación quirúrgica de dicho tendón.

Material y métodos: Estudio retrospectivo de 13 pacientes diagnosticados de rotura de bíceps distal en nuestro servicio desde mayo de 2012 hasta enero de 2014. Todos fueron tratados quirúrgicamente con reinserción anatómica con vía única (69,23% con técnica Endobutton y 30,77% con reanclaje mediante arpones. Se ha valorado los posibles factores de riego, movilidad articular, complicaciones precoces y tardías y satisfacción del paciente (escala de Karunakar). Su seguimiento clínico ha sido de al menos 6 meses.

Resultados: Todos fueron varones con edad media de 42,69 años en brazo dominante en el 92,3%. El 76,92% realizaban deportes para ejercitar el bíceps y el 53,84% tomaba medicación por dislipemia. El resultado obtenido tras el tratamiento fue excelente estando satisfechos la totalidad de los pacientes

Conclusiones y discusión: Los factores de riesgo conocidos hasta la fecha son el tabaco, dislipemia, corticoides, anabolizantes y obesidad que no justifican el aumento de la incidencia actual. La práctica deportiva habitual que implique tonificar y muscular el músculo braquial en pacientes con factores de riesgo aumenta la probabilidad de rotura del tendón distal de bíceps y su reinserción anatómica por vía anterior es una correcta opción terapéutica.

Palabras clave:
Rotura. Bíceps. Factores.

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Introduction

Rupture of the distal biceps tendon is a rare injury that comprises around 3% of the pathologies of this tendon[1]. It appears in middle-aged males (40-50 years) with pre-dominance in the right arm. The rupture is located in the musculo-tendinous junction, which is the weakest area of the muscle-tendon-bone complex and specifically the insertion of the tendon in the radial tuberosity. The aetiology of the rupture of this long-head tendon tends to be traumatic. It occurs upon performing an unexpected extension load applied with the elbow in flexed position[2,] but it can also occur as a result of mechanical over-exertion or as the final phase of a degenerative process[3]. In this case, before the distal biceps rupture the patient, presented clinical tendinitis (painless) and in the histopathological study a pathological alteration can be observed of the tissue prior to the rupture, with degenerative and atrophic changes to the tendon, with disorganised collagen fibres, a reduction in the number of fibroblasts, areas of necrosis and calcification, which could have been caused by a failure within the normal repair mechanism of the tendon due to an anomalous regulation of the metalloproteinases of the extracellular matrix.

Table 1 displays the most frequent causes of tendinitis of the distal biceps tendon[4].

The consumption of steroids, nicotine[4] and statins[5], hyperparathyroidism, chronic acidosis6, and some systems diseases (systemic lupus erythematosus)[7] have been described as risk factors in the rupture of the distal biceps tendon but these do not justify the increase in the incidence rate of this pathology in the past decade.

The biceps are attributed as the male muscle by excellence, which marks the difference between the female and male aesthetic. Over recent years, men's interest in displaying large and well-defined biceps has increased and they achieve this by training with repetitive flex-extension movements, with or without load. Despite its rarity, athletes that perform strength training and practise contact sports may present problems related to this pathology[8].

Good results have been published with conservative and surgical treatment, but recently-published bio-mechanical studies comment that if the distal biceps tendon is not reinserted anatomically, the flex strength is reduced by 30% and the supinator strength by 40%[9]. The majority of the studies recommend operation of acute ruptures of the distal brachial biceps tendon in young patients, with high functional demand, of an active working or sporting age, with whom it is impossible to bring the distal biceps stump of the bicipital tuberosity closer with the elbow at a 70º10 flex. Sutural anchors allow for less dissection and minimises the risk of radial paralysis by a single anterior channel.

Over the last two years, the cases of distal biceps rupture have increased in our clinic. Our aim is to identify the possible risk factors and causes of this increase, and to assess the results following its surgical repair.

Material and methods

A retrospective study has been carried out on thirteen patients, diagnosed and operated with acute rupture of the distal long head of the biceps between November 2012 and June 2014. To demonstrate the influence of risk factors, the following data was collected: age, sex, affected side, profession, antecedents of previous tendinitis pathology (pain in the insertion of the distal biceps and/or muscle belly of the biceps), risk factors, sporting habits and result of the functional test.

The risk factors were taken into account: Smoker or ex-smoker (number of cigarettes smoked a day and years smoking), corticosteroid use (reason for prescription, doses and duration), treatment for dyslipemia (generic name, doses and treatment duration), consumption of anabolic agents (daily doses and consumption time). And pre-disposing factors: profession (in which repetitive flex-extension movements of the elbow are carried out, with or without lifting loads) and sporting habits (strength training and contact sports).

The diagnosis was performed, assessing the pain, swelling, deficit in flex and supination, the presence of a visibly sunken area and the Hook test.

All the patients were given an informed consent form and the advantages and disadvantages of surgical intervention were explained to them. The minimum follow-up after treatment was six months.

The variables were statistically analysed with the SPSS programme (15.0; SPSS Inc, Chicago, Ill).

Surgical technique

By means of an anterior single-incision Henry-type channel, the distal biceps tendon was located and repaired anatomically.

In nine patients (69.23%) the tendon was reinserted using the BicepsButton® technique (Arthrex, Naples, FL), and in four (30.77%) with sutural anchors (Figures 1 and 2).

Table 1. Causes of tendinitis.

Extrinsic factors	Intrinsic factors
– Mechanical overloading. – Increased intensity of the strain. – Increase in the frequency of the strain. – Increase in the duration of the strain. – Technical training errors. – Postural errors. – Working position (ergonomics).	– Anatomical factors. – Malalignment, angular or torsional deformities. – Muscle weakness or agonist-antagonist imbalance. – Vascular insufficiency. – Age-related alterations. Degenerative process of the tendon reduction in intrinsic repair capacity, increase in stiffness, ischemia. – Systemic diseases. – Enthesis associated with spondylo-arthropathies. Others: tendinopathies associated with quinolones.

Figure 1. BicepsButton® Technique: Preparation for tendon insertion.

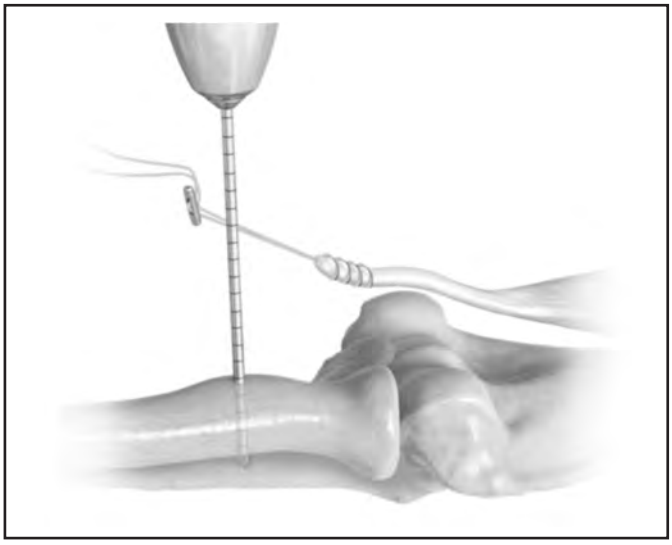

Figure 2. BicepsButton® Technique: Re-insertion of the distal head of the biceps.

Tendon samples from two patients were sent to the Pathology Anatomy Service, whose reports revealed degenerated tendon.

The average waiting time from diagnosis of the rupture to surgical intervention was 6 days (1-11).

An antebrachial splint immobilised the area for 3 weeks and immediately after its removal rehabilitation treatment commenced with passive and active elbow flex-extension. The patients were assessed upon the first, third and sixth month, and a year after the surgery. We assessed the following parameters: mobility, strength, pain and personal satisfaction. Mobility was assessed by comparing it to the contralateral arm and measuring the arch of movement manually with a goniometer. The degree of satisfaction was assessed according to the Karunakar *et al*[11]. scale.

Results

All were males with an average age of 42.69 years (30-65 years) and twelve (92.3%) ruptures were located in the dominant arm. Eleven ruptures (84.6%) affected the right arm and two (15.4%) the left arm. One patient had an antecedent of contralateral rupture (left side). In our study, the rupture was generated in eight cases (61.53%) whilst under strain (six lifting a weight at work or in the gym, another taking a ski-lift button, and the other climbing), in four cases (30.8%) following a trauma to the elbow and in one case (7.67%) following a fall. The patient with bilateral rupture suffered the first following a blow to the non-dominant elbow whilst boxing and the second whilst climbing.

With regards to the different aetiologic factors that appear in the bibliography6, two patients (15.38%) had been smokers for over 7 years and a further two (15.38%) had stopped smoking 2 years ago. Two (15.4%) took corticosteroids on demand due to respiratory pathologies, seven (53.84%) took anti-dyslipemia agents on a daily basis, and two (15.4%) had been taking anabolic agents daily to improve their sporting performance for over 3 months. Three (23.1%) reported an antecedent of tendinopathy (tendinitis) in the years leading up to the rupture and one (7.7%) had a contralateral rupture. Six (46.15%) patients carried out repetitive movements with a load on a daily basis at work, and ten (76.92%) persistently carried out sporting activities in which the brachial biceps muscle worked actively (weights at the gym, climbing and boxing) (Table 2 and Figure 3).

All the patients had at least one risk factor. All, except one, carried out daily repetitive flex-extension movements with a load.

The patients that had carried out mechanical over-exertion (occupational or sporting), suffered more ruptures of the distal tendon (0.05) than those that had not.

Neither taking corticosteroids, anabolic or dyslipemia agents, nor being a smoker were risk factors in the rupture of this tendon ($p < 0.5$).

Figure 3. Risk factors by patient.

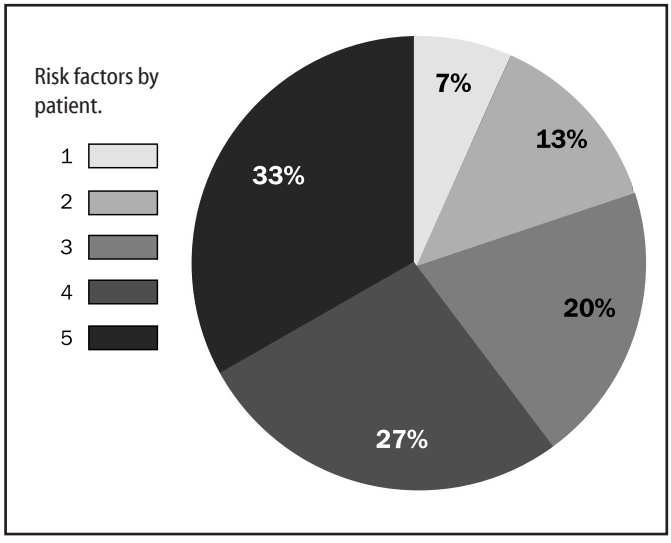

Table 2. Patient risk factors.

Case	Smoker	Corticosteroid	Dyslipemia	Anabolic agent	Tendinopathy	Risky occupation	Hobby
1	No	No	No	No	Yes	Yes	Yes
2	No	No	Yes	No	No	Yes	No
3	No	No	Yes	No	No	Yes	No
4	Ex-smoker	Yes	No	No	No	Yes	Yes
5	No	No	No	Yes	No	Yes	Yes
6	No	No	No	No	No	No	Yes
7	No	No	No	No	No	No	Yes
8	No	No	Yes	No	Yes	No	Yes
9	No	Yes	No	No	Contralateral	No	Yes
10	No	No	Yes	No	No	No	No
11	Yes	No	Yes	No	No	No	Yes
12	Ex-smoker	No	Yes	No	No	Yes	Yes
13	Yes	No	Yes	Yes	Yes	No	Yes

After 6 months, all the patients were able to perform a complete flex, eleven (92.3%) a complete extension and three (23.1%) had a minor limitation in supination. Eleven patients (84.6%) recovered the same strength as the contralateral arm. No patient registered pain. No differences were found ($p > 0.05$) between the two surgical anchoring techniques used.

The degree of personal satisfaction was assessed according to the Karunakar *et al.*[7] scale. Nine patients (69.2%) expressed an excellent degree of satisfaction, and four patients (30.8%) good. No cases of re-rupture were registered. All the patients returned to their work and sporting activities 6 and a half months after surgery[2-8].

Discussion

All our patients were males, they were aged over 30 years and they carried out some kind of sporting activity various times a week, in which the biceps muscle had an actively participative role. The incidence rate of this pathology in women has not varied, despite the increase in sporting activities, because they do not wish to increase the muscular volume of this muscle[6,12]. Karunakar *et al.*[11] in their study, mentioned that the rupture of this tendon usually occurs in men between 40 and 50 years of age, and they also related age and sinew rupture with the decline of the connective tissue's resistance to tension with the ageing process, though they do not statistically prove this. In our study, just as in that of Karunakar *et al*.[11] there is also a histological study that reveals the degenerative and atrophic changes of the tendon, despite this being a slightly younger sample group. To provide statistical evidence, we should have designed a case study (patient with rupture), a control study (patient without rupture), and compared the pathological study of the long-head distal biceps tendon of patients of the same age.

Over the last decade, distal biceps rupture has constituted 10% of the pathology for this muscle, i.e. the incidence rate has increased by approximately 7%.[1]. However, the risk factors described to date have not varied[7]. In our study, the patients that took anti-dyslipemia agents and/or regularly exercised the brachial biceps, presented this rupture. Authors such as Rantanen and Orava[13] have affirmed that athletes were at the greatest risk of suffering from this injury, and in the study conducted by Pullatt *et al.*[5] half the patients had dyslipemia that was treated pharmacologically.

We do not agree with the results from the study by Safran *et al.*[4] in which they conclude that the consumption of corticosteroids and anabolic agents are predisposing factors to the rupture of this injury. We do recognise that 62% of the patients had more than two risk factors, i.e. that as risk factors increase, so does the possibility of acquiring this rupture.

The difficult of this study is obtaining a suitable sample size due to the low incidence rate of this injury. This is only possible if the study duration is extended.

We only proposed surgical intervention to young patients with functional demands, both occupational and sporting, and we ensured that they would follow post-operational recommendations. We preferred to use the anterior and single channel, reinserting the tendon anatomically because according to publications to date, that is the most effective method.

Overall the surgical results were positive; only 23.33% (3/13) displayed limitations in the pronosupination position and 7.69% (1/13) in extended position. In our case we did not have to perform any further interventions and complications were minimal.

In the study performed by Guerra-Vélez *et al.*[14] the best functional results were also obtained in patients in whom the tendon was reinserted anatomically through a single channel.

Despite this being a short series, we conclude that in regular sporting practice, which involves toning and building the brachial muscle, patients with risk factors face a higher possibility of rupturing the distal biceps tendon, and that the anatomical reinsertion by anterior channel is a good therapeutic option.

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Injury incidence in Brazilian football referees

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Received: 14.05.2015
Accepted: 24.07.2015

Summary

Sports injuries have had notoriety in soccer studies. It has long been argue that soccer referee would be susceptible to the same injuries that the players. However, recent studies have shown that lesions that affect the referees are in situations and different sites that affect the players. Therefore, the aim of this study was to analyze the situations and places where the professional soccer referee in the south and southeast of Brazil are injured. The study sample consisted of 36 male referees accredited by the Paulista Football Federation (FPF) and Gaucha Football Federation (FGF). The sample consisted of 17 referees of FPF, mean age 35 ± 4.7 years, height 1.82 ± 0.07m weight 83 ± 7.5 kg. We evaluated 19 referees from FGF, mean age 31 ± 5.9 years, height of 1.82 ± 0.06 m and weight 86 ± 7.1 kg. Three situations were established in the referee once injured this injury would be considered sports injury: during physical evaluation, training, and during the match. When considering all the referees, 19 referees say they have suffered some kind of sports injury in one of the situations described above. Of these ten (10) by referees of FPF and 9 by FGF referees. Of the 22 injuries identified, 59% (n = 13) occurred during training, 23% (n = 5) during the physical test and 18% (n = 4) during the game. The injury types were 45% (n = 10) strains, 45% (n = 10) sprains and 10% (n = 2) fracture. For these data, we can conclude that soccer referees suffering low injuries during a soccer match, with more incidence of injury during training or physical test.

Key words:
Referee. Soccer. Injury.

Incidencia lesional en árbitro de fútbol en Brasil

Resumen

Las lesiones deportivas han ganado importancia en los estudios involucrados en el fútbol. Ha sido durante mucho tiempo estudiado que el árbitro de fútbol sería susceptible a los mismos tipos de lesiones que los jugadores. Sin embargo, estudios recientes han demostrado que las lesiones que afectan a los árbitros están en situaciones y diferentes sitios que afectan a los jugadores. Por lo tanto, el objetivo de este estudio fue analizar las situaciones de aparición de lesiones y su tipología en árbitros de fútbol profesional de las regiones sur y sureste de Brasil.
La población de estudio consistió en 36 árbitros varones acreditados por la Federación Paulista de Fútbol (FPF) y Federación Gaucha de Fútbol (FGF). La muestra está conformada por 17 árbitros de la FPF, edad promedio de 35 ± 4,7 años, altura de 1,82 ± 0,07 m y peso de 83 ± 7,5 kg. Se han evaluado también, 19 árbitros gauchos de la FGF, con edad promedia de 31 ± 5,9 años, altura 1,82 ± 0,06 m y peso de 86 ± 7,1 kg. Fueron establecidas tres situaciones de ocurrencia de lesión del árbitro: durante la evaluación física, durante el entrenamiento y el curso de un partido de fútbol. De la población total encuestada, 19 árbitros manifestaron haber sufrido algún tipo de lesión deportiva en una de las situaciones descritas anteriormente. De estos, 10 ocurrió con árbitros de FPF y 9 con árbitros FGF. De las 22 lesiones identificadas 59% (n = 13) ocurrido durante el entrenamiento, 23% (n = 5) durante la prueba física y 18% (n = 4) durante el juego. Los tipos de lesiones fueron 45% (n = 10) distensiones musculares, 45% (n = 10) esguinces y 10% (n = 2) de fracturas. Para estos datos, se puede concluir que los árbitros de fútbol se lesionan poco durante el arbitraje de un partido de fútbol, con una incidencia más frecuente de lesión durante el entrenamiento o la prueba física.

Palabras clave:
Árbitro. Fútbol. Lesión.

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Introduction

The movements without ball during the game are prolonged and predominately aerobics, meanwhile the activities with ball are of high intensity and anaerobic, thus, the football is a team sports that requires a considerable aerobic capacity and a great ability to perform repeatedly maximum efforts[1]. The no ball exercises include more activity during a game and are mostly aerobic, while the activity directly involved in the game is highly anaerobic[2].

As high-level sport, soccer has been the target of numerous changes in recent years, mainly due to the adoption of different training methodologies and constant increasing of physical demands. This in turn forces the athletes to work near their maximum effort, culminating with greater predisposition to injury[3].

The physical stress of the referee during the match is significant, since during the 90 minutes it performs on average in 1268 different activities[4]. From 4 to 6 seconds the referee changes its motor action during the game[4,5]. In terms of perceptual-cognitive demands, an elite referee takes about 137 decisions observable per game[6]. Furthermore, according to these authors, given the effective time of the game, a high level of referee takes 3-4 decisions per minute. Thus the physical activity of the referees is characterized by a high physical demand with variations of aerobic and anaerobic metabolism, determined by high-intensity movements with changes of direction, acceleration, turns and sprint, which makes the sport has a high incidence of injuries[7].

After a review of the literature related to injuries in soccer referees, it was found that the incidence is poorly investigated. There are few studies reporting on referees' sports injuries, and the studies found were recently published. Two of these were developed with Swiss referees[8,9], international referees FIFA[10] and Brazilian referees[11]. The first three authors conducted an analysis of the incidence of injury in referees only during the match refereeing or during physical training. But the study developed in Brazil expanded the investigative field, as it sought to identify injuries that occurred beyond the playing field and during training sessions, investigating also those that affected the referees during the physical tests imposed by the sports entities which the referees were credited.

The battery of physical tests developed by FIFA to evaluate the soccer referees is controversial, being a much discussed issue and focus of numerous studies[12-14]. However, we only have knowledge of a study aimed to identify the incidence and types of injuries that referees are exposed during the physical tests often applied by the federations, soccer confederations and the largest soccer entity. In addition, most studies developed with referees in Brazil took place in Paraná state, so nothing is known about the situations or incidence of injuries in the referees from other states. Therefore, the aim of this study was to identify the circumstances and consequences of injuries suffered by football referees in the states of São Paulo and Rio Grande do Sul, during the game, the training and the physical test, mainly due these states have teams that are among the most competitive Brazilian soccer.

Material and methods

This study is characterized as a retrospective study aimed to identify the situation, the location and the type of injuries that soccer referees are affected. The procedures adopted in this study are consistent with Resolution 196/96 of the National Health Commission, and was approved by the Research Ethics Committee of the UEPG (resolution 25438/2012). A written consent was obtained from all subjects before the beginning of this study, after a brief but detailed explanation of the nature of the research.

The participants of this study were 36 referees that belong to the FPF (17) and FGF (19). All well experienced refers that acts at the A serie of the Brazilian championship.

The exclusion criterion was used the non-participation of the referees to this event. To collect the data we used a semi-structured questionnaire, applied through interviews by an experienced researcher.

The questionnaire used was proposed by Paes *et al*.[15]. Thus, the questions were standardized in order to accurately characterize the activities related to refereeing only account for sports injuries. So just were considered the sports injuries occurred in three situations previously defined: during a soccer match, during physical training or during the physical tests applied by the federations or the Brazilian Soccer Confederation (CBF), for the referee's physical evaluation. The injuries occurred outside that these three situations were discarded. In addition, the referee was asked: how many times you trained during the week, if there was accompanying a professional, the average duration of these sessions, when he joined the Federation Referee Panel and if he practiced soccer before becoming referee, in one of three ways: professional, amateur or hobby.

The injury definition used was previously proposed by Union Football Association European (UEFA)[16], one injury was defined as a pain or discomfort, resulting in removal of any of the aforementioned activities (training and physical test official refereeing). Were considering five injuries: strain, dislocation, sprain, fracture and contusion. The questionnaire also identified the referee injured sought medical aid and physiotherapy. Finally, it was also possible to collect data necessary for determining the Body Mass Index (BMI) determined by body weight divided by the square of height.

The test developed by FIFA to measure aerobic capacity, consists of 20 runs of 150 m, covered in 30 seconds at intervals of 50 meters walk, traveled in 40 seconds, times indicated for the category of national referees. Already the anaerobic capacity is measured by applying six sprints of 40 meters.

The exposure time in training was calculated on the basis of information provided by the referees during the interview. The exposure time in physical tests was calculated in the same way, however, considering that the referees are tested at least twice a year, by the refereeing department, and this information is used to calculate the time spent in this situation. In the surveyed federations, the referees departments do not store data on the amount of annual performances of the referees and, therefore, the exposure time in the matches cannot be calculated. The risk of injury per 1000 hours was calculated as the number of injuries x 1000 / total hours spent on each of the situations above mentioned[17].

Statistical analysis was performed using SPSS (version 11; SPSS Institute, Chicago, Illinois). For the statistical processing of information was used initially descriptive statistics to group the results as mean values, standard deviation and percentage. Due to the small sample number, adopted the logarithmic conversion to non-standard variables, according to the Gaussian curve in order to use the parametric statistical

parameters. We used the "t" test for independent samples, adopting the significance level of 5%.

Results

The average age of the referees (n = 36) was 32.0 ± 5.6 years. Despite the referees by FGF are younger, as shown in Table 1, this difference was not statistically significant (p = 0.0565). The average body weight of the all sample was 84 ± 7,4kg, and found no significant difference between the weight of the referees measured in each state (p = 0.2007). Regarding the height of the referees both federations had the same height, as shown in Table 1. Thus there was no statistically significant difference (p = 0.4336). Another variable that showed no statistically significant difference was BMI (p = 0.3100).

Fifty two percent (52%) from the entire sample (n = 36) had experienced some type of sports injury (n = 19) in one of the situations described above. Twenty-two (22) injuries were identified; one referee suffered four injuries. The most frequent injuries in referees were strain and sprain. The third type of injury developed by the referees was the fracture, as shown in Table 2. The referees showed no dislocation or contusion.

Of the twenty-two (22) injuries reported, thirteen (13) occurred during physical training, five (5) during the physical tests applied by the FPF or FGF Referees Committee and only four occurred when the referee was refereeing a match. Therefore, 59% of injuries that affect the referees occur during physical training. The types and situations where the referees are affected by injuries can be seen in Table 3. When calculated the incidence of injuries per 1000 hours of activity, the following average values of incidence were found: 0.47 ± 0.11 and 1.41 ± 1.08 injuries per 1000 hours of refereeing; 88.3 ± 27.8 and 166.7 ± 55.5 injuries per 1000 hours of testing for referees of FPF and FGF, respectively.

Table 1. Data from anthropometric evaluation of referees from FPF and FGF.

		Age	Weight	Height	BMI
Referees (FPF)	Mean	35.0±4.7	83.0±7.5	1.82±0.07	24.81±1.4
Referees (FGF)	Mean	31.0±5.9	86.0±7.1	1.82±0.06	24.86±1.3

Table 2. Types and location from injuries occurred in soccer referees by FCF e FGF.

Injury	Location	Referee (FPF)	Referee (FGF)
Sprain	Ankle	4	4
	Knee	1	1
Strain	Anterior thigh	1	0
	Posterior thigh	2	4
	Calf	3	0
Fracture	Ankle	1	0
	Feet	1	0

With regard to physical preparation, the referees involved in this study (n=36) reported train frequency of 4.0 ± 1.1 times per week, with an average duration of 60 ± 25.9 min. There was no statistically significant difference in the frequency (4±1.1 vs 1.1±3 times a week, p= 0.0861) and the duration of each training session (60 ± 26.7 vs 60 ± 25.8 min, p= 0.8981) between the referees of FPF and FGF. Regarding the preparation and monitoring of the physical training by a professional of Physical Education, nine referees of FPF reported train with a physical education professional, yet eight (8) training on their own. However, referees by FGF mostly train on their own, since that eighteen (18) they said train without professional supervision of physical education.

When asked about his experiences in the professional soccer before becoming referees, eight (8) referees reported having practiced soccer professionally. The largest number of referees (n = 14) reported having practiced soccer in an amateur way. Already eleven (11) referees said only have had contact with soccer in leisure time. Only three referees reported not having any kind of contact with soccer before they entered the refereeing.

Discussion

The scientific nature of work involving soccer referees is very recent and scarce, if we take as reference the studies involving players[17]. However, the referees involved in this study had ages, weight and height (Table 1) similar to the data of research involving Danish[4], Italians[18], Chilean[19], Brazilian[20,21] and international referees from FIFA[22].

Location and types presented by this study involving referees were similar to those reported in earlier research developed with Swiss referees[8,9], for FIFA international referees[10] and Brazilian referees[11].

At nineteen (19) referees who have been affected by injury, 85% said they had sought medical help in order to injury severity, and shortly after this diagnosis, they were subjected to physical therapy programs. According to the data presented in Table 2, the referees reported only three types of injury, the most common being the sprain and strain. The mean time of recovery from strain reported by the referees was 44 days on average. The time reported by the referees to return to refereeing is greater than the time described in the literature for the recovery of a player due a hamstring injury. Yoon *et al.*[23] investigated the injury incidence in Asian tournaments found that 45,3% of strain injuries, removing the athletes for more than four days of practices and games. Lopes *et al.*[24] in a clinical muscle injury study, reported that the shortest period necessary for healing and functional rehabilitation is between two to three weeks. The same authors reported that the presence of bruising, 24h after injury, determines a serious injury, with a six to eight week prognosis. Cross *et al.*[25] evaluated the prognostic quadriceps muscle injury and noted that the central tendon injuries took an average time of rehabilitation from twenty-seven (27) days. The longer time required to recover the referees may be due to the players have at their disposal a group of specialist sports injury that act immediately after the injury, and in addition, the athlete in 24h is available for work physiotherapy.

Soccer referees in several countries, including where soccer is highly competitive, as in Italy, Spain, Portugal and Brazil, so the match refereeing is used only for supplement their family income, not, therefore, their

full time professional activity. However, despite the short time every day that the referees have to train to accompany the moves during a game no matter the pace that they occur[26]. To improve this situation, the UEFA and FIFA have moved on to professionalize the soccer referees in recent seasons[13].

All injuries reported by the referees occurred in the lower limb (Table 2), this is another similarity between the injuries that affect soccer referees and players. A study of the topography of injuries involving players in soccer, held for 64 games of the World Cup 2002, found that the injuries sustained during this competition affected predominantly the knee joints, ankle, thigh and calf muscles[27]. Another study during soccer competitions organized by FIFA and the Olympic Games between 1998 and 2001, it was found that the injuries occurred mainly in the ankle (17%), thigh (16%), leg (15%) and knee (12%), that is also the inferior member[28].

The referees have a higher number of injuries in training than in the game (Table 3) and this is an unusual situation because the distance covered by the referee is similar to soccer player. According to the scientific literature soccer referee covered distances between 9 and 12 km during the game[22] and, the soccer player during the match, in particular the midfielder, also covered between 9 and 12 km during the match[23].

The highest number of injury during training suggests that the referees may be undergoing a very high training load and inadequate exercise, since 80% of injured referees reporting train without accompaniment of a physical education professional. Corroborating our findings it was found that during the preparation of referees for the World Cup 2006 the most damage occurred also during training[10]. Players have a higher number of injuries during the game due to stroke (contusion), ie, players have more ankle injuries and knee, due there is constant contact between them. However, muscular injuries were also higher than other types of injuries in a study involving soccer players in Brazil[29].

Another factor that contributes to the greater number of muscle injuries in referees can be explained by the low level of flexibility shown by these professionals. In a study conducted with soccer referees, to check the mobility of the hip joint, since the main limitation of maximum mobility is observed in the posterior thigh muscle structure[30]. Therefore, low flexibility observed in referees contributed to injuries that occur mainly in the muscles of the back of the thigh, as in this study (Table 2), since the reduction or lack of flexibility is a limiting factor for sport performance being a facilitator for muscular injuries[7].

To try to reduce the high number of injury to referees during training, it would be necessary to develop training programs that consider not only the physical demands of the referee during the match, but also the energy needs for the performance of physical tests FIFA because if they cannot succeed in these, cannot refereeing in official matches.

Table 3. Type and situations where referee suffered injuries.

Injury type	Training	Test	Match
Strain	5	3	2
Sprain	6	2	2
Fracture	2		

Thus decrease the number of injuries not only during training but also during the physical tests, the two situations shown in this study where there is a large incidence of injuries (Table 3). Actually, due the amount of injury occurred in soccer, the FIFA had been developed a specific program for injury reduction by soccer referees[31].

The weekly frequency of training of referees studied was 4.0 ± 1.1 times per week, with an average duration of 60 ± 25.9 min. The session number dedicated to the weekly training of the referees of this study was similar to that reported by national level referees in Brazil[11]. However, the duration of the session was lower, since the elite referees of CBF train an average of 75 minutes per session[11]. Physical activity practiced by most referees during training is aerobic running, being ignored by them anaerobic work as intermittent races. The main result of this study is that the referee trains with frequency, duration and type of physical activity compatible with the minimal quantity of physical activity recommended by health maintenance. This has also been observed and discussed in another country. Krustrup and Bangsbo[4] developed a study with Danish referees and reported that the training of high-class referees often consisted of moderate intensity running between 3 and 7 km.

The majority of the referees increase the intensity and frequency of training, especially nearly of the physical tests applied by the federations or the confederations. This is because, as noted above, if do not achieve success in the tests may not settle any competitive games. As the referees know that the test there evidence anaerobic (sprinting) begin to practice them without a gradual preparation and expert guidance, so occurring the injury.

As already highlighted, the second largest number of injury occurs when the referees are performing the physical tests determined by FIFA (Table 3). These tests are performed in athletics track, that is, on a more regular surface that soccer field. This may account for the low number of sprains in this situation. However, there is the presence of muscle injuries (strains) and it is attributed to the exaggerated physical effort applied by the referees in the tests in order to pass the test.

In two states where it aims to evaluate the physical performance of the referees in FIFA fitness tests, it was found that most reproved during performance of anaerobic tests, when compared to the number of failures in aerobic test[32,33]. The large number of failures in anaerobic evidence shows that the referees were not prepared to run these types of motor action.

Studies show that soccer referees to be able to refereeing national and international games, they need to have some years of experience[34] so the referees studied here had an average age of 32 years old and 11 years of experience. In the study involving Swiss referees was observed that the older referees had a higher number of injuries[9] and the same occurred with the study of Brazilian referees[15]. Arnason *et al*.[35] report that increasing age elevated the risk factor for injury in soccer players. The age difference between players and referees can be justified by the item experience because Refereeing Committee by FIFA and UEFA considering as a fundamental for the individual enter to the elite group of refereeing[36]. Thus, the referees should undergo specialized training program to ensure an appropriate level of physical preparation to conduct an official soccer match and be subjected to physical tests, mainly considerer with increasing age there was a greater predisposition for sports injuries.

Conclusion

After analyzing the data, we concluded that soccer referees have a higher incidence of injury during training and fitness test. The most frequent injury is the strain, more specifically in the thigh. It was also found that most of the injured referees undergo physical training without the accompaniment of a professional of Physical Education, and the duration, weekly frequency and type of training unsuitable for a person to present himself as a soccer referee, as this sport is highly competitive. Therefore, the associations should be responsible for the provision of training programs for referees, with specialized professionals, this could help minimize the appearance of injuries over the years, as the referees can act in this sport until 45 years of so that thus they would be less exposed to injury occurrence in the three situations investigated.

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DE VENTA EN CENTROS ESPECIALIZADOS EN SALUD

Consensus on the use of infiltration in sport. Document of Consensus of the Spanish Society of Sports Medicine

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Summary

Infiltration is a therapeutic option used for the treatment of various diseases, which comprises injected administration into precise locations of different substances. They may have an analgesic and / or anti-inflammatory and healing effect.
Its use is common in the treatment of many soft tissue injuries such as bursitis, synovitis, plantar fasciitis, sprains, muscle injuries, tendinopathies and chondral injuries and must be preceded by the appropriate diagnosis.
Almost all local infiltrations have mild side effects and, sometimes, these may be systemic and may have some specific contraindications depending on the administered substance. Most of the adverse effects are caused by improper use of the drug.
The most used active substances are: *local anesthetics* that produce immediate pain relief, such as lidocaine and bupivacaine. They can be used alone or in combination with corticosteroids producing an immediate analgesic combined effect on local pain and a therapeutic effect of longer duration. *Corticosteroids,* whose main property is a very powerful anti-inflammatory action. The most used are betamethasone, methylprednisolone and triamcinolone. *Hyaluronic acid,* used in the treatment of joint diseases, particularly knee osteoarthritis and chondromalacias/chondropathias . It lubricates joints and appears to have direct effects on the function of synovial cells and synovial fluid. *Sclerotherapy,* which is the introduction of a chemical substance in the light of the blood vessels, causing obliteration and secondary fibrosis. It is indicated mainly in tendinopathies with vascular proliferation. *Biorregulators:* They stimulate healing when modulate or activate various involved substances. *Platelet-rich plasma:* autologous plasma containing more platelet concentration that normal blood, secreting a large amount of growth factors. *Prolotherapy,* it consists in substances infiltration that stimulate regeneration and tissue repair. *Other:* Nonsteroidal anti-inflammatory drugs, growth factors, stem cells and related therapies.

Key words:
Consensus. Injection. Infiltration. Soft tissues. Injury. Sport.

Consenso sobre utilización de las infiltraciones en el deporte. Documento de Consenso de la Sociedad Española de Medicina del Deporte

Resumen

La infiltración es una opción terapéutica, utilizada para el tratamiento de diversas patologías, que consiste en la administración inyectada en localizaciones precisas de diferentes sustancias. Pueden tener un efecto analgésico y/o antiinflamatorio y curativo.
Su uso es frecuente en el tratamiento de muchas lesiones de tejidos blandos como bursitis, sinovitis, fascitis plantar, esguinces, lesiones musculares, tendinopatías y lesiones condrales y deben de ir precedido del correspondiente diagnóstico.
Casi todas las infiltraciones tienen efectos secundarios locales, leves y, en algunas ocasiones, sistémicos y pueden presentar algunas contraindicaciones específicas que dependen de la sustancia administrada. La mayor parte de los efectos adversos son debidos a uso inapropiado del medicamento.
Los principios activos más utilizados son: *Anestésicos locales* que producen un alivio inmediato del dolor, como lidocaína y bupivacaína. Se pueden usar solos o en combinación con corticosteroides ejerciendo un efecto combinado analgésico inmediato del dolor local y un efecto terapéutico de mayor duración. *Corticoides* cuya propiedad fundamental es una acción antiinflamatoria muy potente. Los más utilizados son betametasona, metilprednisolona y triamcinolona. *Ácido hialurónico,* utilizado en el tratamiento de patologías articulares, especialmente la artrosis de rodilla y las condromalacias. Lubrifica las articulaciones y parece tener efectos directos sobre la función de las células sinoviales y el líquido sinovial. *Escleroterapia,* que es la introducción de una sustancia química en la luz de los vasos sanguíneos, provocando una obliteración y fibrosis secundaria. Está indicada fundamentalmente en las tendinopatías con proliferación vascular. *Biorreguladores:* Estimulan la curación al modular o activar diversas sustancias implicadas. *Plasma rico en plaquetas:* plasma autólogo que contiene más concentración de plaquetas que la sangre normal que segregan una gran cantidad de factores de crecimiento. *Proloterapia,* que consiste en la infiltración de sustancias que estimulan la regeneración y reparación de los tejidos. *Otros:* Antiinflamatorios no esteroideos, factores de crecimiento, células madre y terapias relacionadas.

Palabras clave:
Consenso. Inyección. Infiltración. Tejidos blandos. Lesión. Deporte.

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Introduction: evidence and utility

Infiltrations consist in local drug administration either by puncture or injection into soft tissue and joints. These therapeutic techniques are frequently used in a number of pathologies of the musculoskeletal system, for the purpose of achieving analgesic and anti-inflammatory effects and for healing injuries. Although some injectable drugs have proven efficacy in the treatment of sports injuries, the benefits of many others remain questionable[1]. In most cases, infiltrations are not considered to be a first choice treatment and are generally administered when the more conservative therapies have failed. They offer patients a therapeutic alternative to other routes of administration and, on occasions, their use leads to a faster return to training and competition.

As well as Sports Medicine specialists, infiltrations are also often used by anaesthetists, traumatologists, rehabilitation doctors, rheumatologists and general practitioners as a therapeutic option. Although they are almost always used for their analgesic, anti-inflammatory and / or tissue regeneration effect, on occasions they may also be used for diagnostic purposes[2].

Although a number of studies have been published on the effects of the infiltrations of different substances, the poor quality and methodological uniformity in many of these studies, as well as contradictory results, forces us to be cautious when evaluating their effectiveness[3]. Amongst the many sources of controversy, we could cite the following:

- the lack of knowledge, in many cases, of the etiopathogenesis of the problem being addressed;
- the choice of drug, dose level, the moment at which the infiltration is performed, the number of sessions and frequency;
- the administration technique used;
- care and rehabilitation following the process;
- the result is due to the substance, placebo effect, the puncture itself and/or the dose level administered.

Therefore, on many occasions, the guidelines are more based on personal experience than scientific evidence. Even so, their use is recommended in a number of therapeutic use guides[4].

In any case, although this is a simple technique, it does require a thorough knowledge of musculoskeletal disorders, the anatomical site where the infiltration is to be made and the substances to be administered. Moreover, it is essential to make a proper patient selection and to perfuse the minimum effective quantity of the correct drug, at the precise site and at the right time. Many of the problems that may arise with infiltrations are related to a poor choice of drug, incorrect dose level, the injection at an incorrect site or tissue, excessive frequency, or forgetting the cause or origin of the injury in addition to the subsequent care and rehabilitation[5,6].

Indications

Independently of the use of infiltrations of a number of substances in patients with autoimmune diseases (rheumatoid arthritis, juvenile chronic arthritis, systemic lupus erythematosus, etc.), spondyloarthropathies, gout, degenerative osteoarthritis, etc., as far as sport is concerned, soft tissue and joint infiltrations have been made for decades for analgesic and anti-inflammatory treatment in order to regain functional limitations or joint stiffness, to speed up the healing of certain injuries and to reduce or eliminate the need for more aggressive treatments. On occasions, the administration of a substance is preceded by the aspiration of intra-articular fluid (synovial fluid, haemarthrosis) intra-muscular fluid, etc. The last few years have witnessed an upswing in its application in regenerative therapy. Local anaesthetics are also frequently used to confirm a presumptive diagnosis by alleviating the symptomatology.

The injection of substances or drugs is very common in the treatment of a large number of pathologies or soft tissue injuries (muscles, tendons, ligaments, fascia, bursae, etc.): inflammatory problems such as bursitis (subacromial, goosefoot, pre-patellar, trochanteric, isquiatic, olecranon) or plantar fascitis; tendinopathies (patellar, achilles, supraspinatus, bicipital, epicondylitis, medial epicondylitis, De Quervain's tenosynovitis, etc.); sprains; muscle injuries; calcaneal spur; nerve entrapments (carpal tunnel syndrome, Morton's neuroma) and trigger points. In joint pathology, they are used in the treatment of synovitis and chondral and ligament injuries of traumatic or unknown origin[7].

The application of drugs through this route of administration must be justified by the expected benefits for each particular patient and type of injury. In order to perform an infiltration, there must be a clear diagnosis of the injury and rationale for treatment. Furthermore, there is a need to know the dose level, the application technique, any undesirable effects of the drug and contraindications.

Almost all infiltration of substances to treat pain, inflammation or tissue degeneration, have side effects, which are sometimes serious, and must be taken into account. Moreover, they could have undesirable effects, with particular mention of:

- Transitory pain after injecting the drug.
- Local haematoma.
- Infection.

With regard to the dose level for the majority of substances used, there are no specific criteria or consensus, neither are there a recommended number of infiltrations or the time interval between one infiltration and another.

Contraindications

There are circumstances in which infiltrations must never be performed and others in which there is a relative contraindication and the infiltration may be performed if the risk can be assumed. When in doubt, it is preferable not to perform the infiltration.

Absolute contraindications

- Hypersensitivity or allergy to any of the drugs used (risk of an anaphylactic reaction).
- Local or systemic infections.

- Risk of tendon rupture. Intra-tendon injections should be avoided, as they weaken the tendon and increase the risk of rupture (corticosteroids in particular).
- A recent fracture site, as it can delay the formation of the callus of the fracture.
- For joint prosthesis, due to the risk of infection.
- Minors under 18, with the exception of some chronic diseases.
- Medical - legal aspects such as the lack of informed consent or patient reticence.

Relative contraindications

- Risk of bleeding. For patients on anticoagulant treatment, with no clear evidence of the risk of bleeding, then infiltrations can be permitted.
- Diabetes Mellitus. There is a greater risk of sepsis.
- Secondary immunosuppression to disease or drug therapy.
- Pregnancy.
- Psychogenic pain, given the fact that an increase in the perception of pain may occur.
- Lack of positive results.

Conditions

The use or prescription of parenterally administered substances for diagnostic and/or therapeutic purposes to professional athletes requires knowledge of, and compliance with, the national and international anti-doping legislation, up-dated on an annual basis (www.aea.gob.es, www. wada-ama.org).

Before performing any infiltration, the patient must receive written and verbal information on the type of procedure in addition to the associated risks and benefits, and must sign an infiltration consent form.

In order to reduce the risk of infection, strict sterile conditions must be maintained, particular with regard to an intra-articular injection.

Provided that the skin is intact and in order to alleviate the pain produced by the injection, it may be useful to use ice, cooling sprays and topical anaesthetics (cream or patches with lidocaine, alone or in combination with other anaesthetics).

From a technical point of view, professionals performing infiltrations are required to have considerable anatomical knowledge of the site and, in this respect, an ultrasound scan leads to increased accuracy, thereby reducing the risk of complications[8,9]. An ultrasound scan is primarily used in small joints and soft tissue, for radiation-free, real-time viewing of the tissues and needle, thereby avoiding contact with vessels, nerves and fascia, as well as tendons, unless these are the target of the procedure (neo-vessel sclerosis in tendinitis). Fluoroscopy, CT and magnetic resonance are primarily used for large joints, the spine and sacroiliac joints, although the ultrasound scan is becoming increasingly more decisive in this field[5,9].

Imaging techniques may be of particular help and are reserved for the following circumstances and sites[6,10]:

- When the injection or aspiration has failed.
- When the objective is fundamentally for diagnostic purposes.
- For obese patients.
- Spinal infiltrations.
- To verify a site in research studies.
- To monitor the effects of the infiltration.

Types of infiltrations

Based on the application site, infiltrations can be classed into intra-articular and extra-articular or soft tissues. The route for extra-articular infiltrations can be either intradermal, subcutaneous, intramuscular or intravenous, whilst a number of therapeutic techniques can be used (biopuncture, mesotherapy, etc.).

Active ingredients and substances used

Local anaesthetics

Local anaesthetics either reversibly reduce or block the nerve conduction through the blockade of Na^+ channels, causing the temporary loss of the autonomic, motor and/or sensory functions. They act by reducing the membrane depolarisation rate, thereby increasing the electrical excitability threshold. The blocking affects all the nerve fibres: Autonomic NS, sensitive NS and motor NS, sensations are gradually lost in the following order: pain, temperature, touch, proprioception and muscle tone[11].

This is extremely useful with regard to therapeutics (analgesia), diagnosis (to confirm the source of pain), as a medium to dilute other substances (corticosteroids, ...) etc. From a therapeutic point of view, the local injection of anaesthetics provides immediate pain relief.

Local anaesthetics are classed into esters and amides, depending on the type of link contained (Table 1). The clinical use of esters is limited to local anaesthetics, due to their instability and to the fact that they frequently cause allergic reactions.

Table 1. Types of local anaesthetics.

Esters	Amides
Benzocaine	Articaine
Cocaine	Bupivacaine
Novocaine	Cinchocaine
Oxybuprocaine	Etidocaine
Procaine	Lidocaine
Tetracaine	Levobupivacaine
	Mepivacaine
	Prilocaine
	Ropivacaine

Amides are more frequently used for local infiltrations and particularly 1% or 2% lidocaine and 0.25% and 0.5% bupivacaine (especially for nerve blocks). Lidocaine and mepivacaine (1 or 2%) are characterised by a rapid onset of action (1-2 minutes and even shorter for mepivacaine) and shorter duration (1 hour and slightly more for mepivacaine which produces less vasodilation), whilst bupivacaine has a slow onset of action (30 minutes) and a greater duration (8 hours) (Table 2).

Amides are safer than esters, and should be used without a vasoconstrictor given the fact that, although vasoconstrictors serve to increase the duration of the anaesthetic effect, reducing bleeding and the adverse systemic effects, their use can produce tissue necrosis and delay the healing of surgical wounds[12].

Indications for the infiltration of anaesthetics

In sporting terms, local anaesthetics are used to alleviate pain in joint, tendon, ligament, skeletal, bursa injuries, etc. for an earlier return to sports activity, thereby reducing the number of injured athletes. In competitions, in the event of pain, anaesthetics are frequently used to block pain and achieve maximum performance; within the therapeutic arsenal available, this is a medical procedure that offers risks and benefits. Provided that the benefits are greater than the risks, then this procedure can be justified[13].

Logically, the anaesthetic effect will block all kinds of sensations at a local level. Therefore there will be a loss of proprioception with all its consequences. As a result, amongst some professional groups, its use as a therapeutic method to block pain is considered to be unethical, and is prohibited in some organisations, whilst others support its administration[12-14].

Local anaesthetics can be used alone or in combination with corticosteroids, exerting a combined effect to provide immediate relief of local pain and a longer-lasting therapeutic effect provided by the corticosteroid[15]. The combination also increases the area of distribution, avoiding high concentrations of corticosteroids in a small site. Manufacturers advise against mixing corticosteroids with lidocaine, due to the risk of flocculation and the precipitation of steroid crystals.

At the moment, there are no specific guidelines for prescribing anaesthetic infiltrations, which makes it even more difficult for Sports Medicine professionals to make a decision of this nature[13].

Table 2. Properties of anaesthetics.

	Short	**Medium**	**Long**
Latency	Chloroprocain Mepivacaine Etidocaine Lidocaine	Bupivacaine Levobupivacaine Ropivacaine	Procaine Tetracaine
	Low	**Medium**	**High**
Potency and of effect	Chloroprocaine Procaine	Prilocaine Mepivacaine Lidocaine	Bupivacaine Levobupivacaine Ropivacaine Tetracaine

Side effects

Although rare, local anaesthetics can provoke local reactions or systemic effects, whilst most adverse effects are due to improper drug use[16,17].

Amongst the local side effects, particular mention should be made of the following:

- Erythema, itching, tingling, bruising, pain at the infiltration site, infections, vascular or nerve injuries due to mechanical damage.
- Muscle injuries due to the direct infiltration on the muscle, particularly affecting small muscles, with the possibility of causing tissue necrosis (myotoxicity).
- Nerve tissue injuries due to direct injection or through prolonged exposure to the anaesthetic agent (neurotoxicity).
- Infiltrations in an injured muscle, tendon or ligament could create a greater risk of rupture or a deterioration of the injury.
- Although systemic reactions are uncommon, if they do occur, they could be fatal. They are generally due either to an overdose or to intra-vascular infiltrations[17,18].
- Although highly uncommon, some of the most serious adverse effects include allergic reactions when using esters. This is due to the fact that it has PABA as an intermediate metabolite, which stimulates allergic reactions in pre-sensitised patients.
- Vasovagal reactions with hyperventilation, paresthesias or vagal symptoms.
- On rare occasions, cardiovascular manifestations may occur, related to the plasma concentration and to the anaesthetic agent used; these are more frequent with bupivacaine[13].
- Infiltrations with high dose levels of prilocaine, articaine and benzocaine can cause methaemoglobinemia.

Corticosteroids

Corticosteroids were first used in local intra-articular injection in the middle of the last century[19] and, from then onwards, they have been widely used in the sports sector. The most commonly used agents for infiltration are synthetic analogues of the endogenous cortisol (hydrocortisone) segregated in the adrenal cortex.

Once administered they combine with certain intracellular receptors that control the gene transcription, modifying the synthesis of certain proteins. They act on the carbohydrate metabolism, the lipids and proteins at a locomotor system level, on the cardiovascular system, the central nervous system and on other hormones.

Their use in the treatment of sports injuries is primarily due to their extremely potent anti-inflammatory effect. They inhibit all the inflammation stages, early and late (fibroblastic proliferation, healing and cell proliferation) without acting on the underlying causes.

The anti-inflammatory effect is produced by inhibiting the A2 phospholipase protein, blocking the production of different pro-inflammatory mediators (leukotrienes, porstaglandins, thromboxanes and prostacyclin), stabilising the lysosomal membrane of the inflammatory cells, reducing the local vascular permeability and modifying the chemotaxis and the functioning of the neutrophils[20,21]. Furthermore, they inhibit the release of eosinophils and reduce the activity of the B and T lymphocytes.

Table 3. Type of corticosteroids according to the duration and potency of their effects.

Long duration (36-54 h) High potency	Betamethasone Dexamethason
Intermediate duration (18-36 h) Medium potency	Deflazacort Methylprednisolone Prednisone Prednisolone Triamcinolone
Short duration (8-12 h) Low potency	Hydrocortisone (Cortisol)

On the other hand, with regard to their side effects, account should be taken of the fact that, as well as the anti-inflammatory effect, they also stimulate gluconeogenesis and increase the catabolic activity in the muscles, skin, connective tissue, adipose and lymphatic tissue.

Although all corticosteroids can be used in local infiltrations (Table 3) the most popular are those with delayed effects or with the chemical characteristics of fat-soluble esters (acetate or acetonide), because absorption is slower and the therapeutic effect is therefore of longer duration. The most used are betamethasone, methylprednisolone and triamcinolone[20,21].

The duration of effect is inversely proportional to the solubility of the agent. The most soluble (dexamethasone and betamethasone) have greater systemic effects; triamcinolone and methylprednisolone are of an intermediate solubility and duration and are most used in soft tissues; the least hydro-soluble corticosteroids (acetonide and triamcinolone hexacetonide) are most used for intra-articular infiltrations and their use is not recommended in soft tissue due to the increased risk of tissue atrophy[7,22,23].

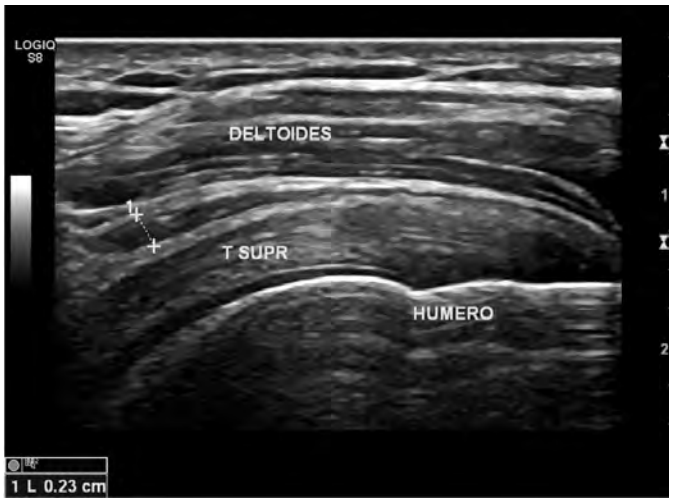
Indications

There is considerable disagreement with regard to the clinical use of local infiltrations with corticosteroids (alone or combined). Whilst some professionals support their use for the treatment of some tendinopathies[24], tenosynovitis[25], bursitis[26,27], sprains or simply as painkillers[2], others can find no benefit. In any case, with corticosteroids, there is always the need to observe the principle of using the smallest possible dose for the shortest possible time.

Local infiltrations are only recommended when conservative treatment has failed (rest, exercise, physiotherapy, orally administered anti-inflammatory medication) and when the anatomical site that is the source of the symptom can be located (Figure 1). No more than three injections should be applied, spaced several weeks apart, and with repeat injections given only if previous ones have proved to be successful. Following corticosteroid infiltration, patients are normally recommended to rest for 3 to 7 days.

There are few clinical indications for the use of intra-articular corticosteroids, amongst other reasons because they can inhibit the formation and repair of the articular cartilage, particularly when used at high dose levels. The primary objective of most articular infiltrations is to remove the pain, thereby improving the joint function.

Figure 1. Subacromial bursitis. A long axis examination of the supraspinatus tendon shows that, above it, the bursa has a thickness of more than 2 mm.



For load-bearing joints, some authors advise considerable caution due to potential chondral damage caused by corticosteroids in the long term[28]. For others, there are few cases of steroid arthropathy described in the literature and always following a high number of injections[29]. The recommendation to infiltrate with intervals of at least three months is mostly based on consensus than on true scientific evidence. However, at least for the knee, with this frequency and for two years, it appears safe[30]. In any case, the use of corticosteroids shall only be considered if other conservative treatments have failed.

The simultaneous infiltration of a number of large joints should be avoided, as this increases the risk of suppression of the hypothalamic–pituitary–adrenal axis.

Evidence that tendinopathies are not associated with the presence of inflammatory cells is one of the reasons why corticosteroids are no longer used in this type of pathology[31,32]. Compared to other conservative treatments and even to placebo, the local injection of corticosteroids in epicondylitis demonstrated an improvement in the short term, yet in the medium term (after 6 weeks) and long term, the evolution was worse[3,33,34]. A systematic review by Koester *et al.*[35] could find no evident improvements with infiltrations in the treatment of rotator cuff disease. Therefore, for chronic non-inflammatory tendinopathies, steroids should be used in moderation[36].

Another reason for questioning the treatment of tendinopathies with corticosteroids is the fact that data are available indicating that they cause non-beneficial cell and extracellular matrix tissue disorders[37].

Despite the fact that a significant improvement is found, the results of the studies made on bursitis (anserine and trochanteric) must be questioned given the fact that they are mainly observational in nature and lack a control group[26,27,38].

Nowadays, the local infiltration of corticosteroids in muscle injuries is not recommended despite the fact that some studies[39] found a shorter recovery time, however this is questionable due to the poor methodological design of the studies.

In general, although application is extremely widespread in the world of sports medicine, its benefits have not been validated in those pathologies in which inflammation is only a secondary reaction[40]. On the other hand, it has been confirmed that corticosteroids behave differently according to the type of injury and the damaged tissue. Infiltrations of corticosteroids are never recommended immediately after the injury, before a competition or in the event of concomitant infection.

The dose level depends on the type of tissue and the size and seriousness of the injury. For joints, the quantity of hydrocortisone to be infiltrated ranges from 10 to 25 mg for small joints and soft tissue and 50 mg for large joints. The dose level of methylprednisolone ranges from 2 to 10 mg for small joints and soft tissue and 10-80 mg for large joints. The dose level of dexamethasone ranges from 0.5 to 3 mg for small joints and soft tissue and 2-4 mg for large joints. Betamethasone should be applied in dose levels from 1 to -3 mg for small joints and soft tissue and 2-6 mg for large joints.

Infiltrations with betamethasone are more effective than with methylprednisolone and triamcinolone as pain relievers[41].

They are frequently used in combination with a local anaesthetic, basically due to their almost immediate analgesic effect, which also helps to confirm the correct location of the needle. However, the combination with an anaesthetic may slightly increase the risk of infection and provoke the precipitation of crystals and a reduction in the bioavailability of the corticosteroid[5,6].

Side effects

Adverse effects are rare and, when they do occur, they are generally minor and temporary in nature[3]. At a local level, they may be associated with the infiltration at an inadequate site or with an excessive dose. The most common side effects are: pain, which generally appears 24-36 hours following injection, sometimes due to cortisone crystallisation, bruises, local erythema, infections at the infiltration site (cellulite, abscesses, bursitis, arthritis…), cutaneous atrophy, subcutaneous fat atrophy and skin depigmentation or hypopigmentation, occurring between 6 and 12 weeks after injection.

Infiltrations in tendons, fascia and ligaments increase the fragility and the risk of rupture[42,43]. With regard to this latter effect, studies on tenocyte cultures with dexamethasone have demonstrated a dose-dependent decrease in tenocyte proliferation, collagen production and tendon progenitor cell recruitment[44]. It appears that peritendinous infiltrations may also affect the mechanical properties of the tendon, similar to the negative effects of the intra-tendinous infiltrations, increasing the risk of rupture[40,42,43,45].

Systemic effects (in general these are rarely found with local infiltrations, although the risk is slightly greater when injected in soft tissue):

- Post-infiltration vasovagal reaction.
- Decreased cellular and humoral immunity, with increased susceptibility to infections.
- Dyslipidemia, HBP, thrombosis, vasculitis.
- Hyperglycaemia - glucose intolerance due to increased gluconeogenesis and insulin resistance.
- Menstrual alterations, due to alterations in gonadotropin secretion.
- Cushing's syndrome.
- Facial flushing.
- Gastritis, peptic ulcer, gastrointestinal bleeding, pancreatitis.
- Osteoporosis-osteonecrosis due to increase protein catabolism.

Contraindications

Corticosteroid infiltrations are contraindicated when there is hypersensitivity to the drugs or when there is a record of adverse reactions, in the event of fractures, when there is a risk of tendinous rupture or in the presence of concomitant infections. Neither are they recommended when there is no precise diagnosis, if the injury is very recent, during competitions or in the absence of informed consent.

Moreover, care should be taken when the patient has uncontrolled diabetes or HBP, osteoporosis, a history of avascular necrosis, coagulation disorder, thrombocytopenia, or joint replacements at the infiltration site.

Hyaluronic acid (HA)

Hyaluronic acid is a glycosaminoglycan lubricant specifically used in the treatment of joint pathologies. It is most frequently used in the treatment of large joint pathologies, specifically arthrosis of the knee joint and Chondromalacia.

Many studies are in favour of its use in cartilaginous injuries given the fact that there is at least a clinical improvement for an extended period of time in a high percentage of cases. It appears to cause the normalisation of the synovial fluid viscoelasticity and to stimulate the regeneration of the chondral tissues.

It lubricates the joints and appears to directly affect the function of the synovial cells and synovial fluid[46,47]. The articular cartilage and synovial fluid are known to have different concentrations of HA depending on their physiological state, whilst osteoarthritic joints have a lower concentration of HA than healthy joints.

According to some studies, exogenous HA may increase the endogenous synthesis of chondrocytes and proteoglycans, prevent the degradation of the cartilage and promote its regeneration. On the other hand, it may reduce the production of pro-inflammatory mediators and matrix metalloproteinases and reduce the nervous impulses and sensitivity of the nerves associated with joint pain[48].

Therefore, the intra-articular infiltration of HA (Viscosupplementation) will improve the quality of the synovial fluid and its viscoelasticity.

The treatment of osteoarthritis with hyaluronic acid is yet another alternative, particularly for those patients with a poor response to non-drug therapy or to analgesics and orally-administered NSAIDs[49].

It has also been seen that, for some tendinopathies (epicondylitis) it has better effects than the placebo[3,50], although the response is not satisfactory in all cases.

There are a number of types of hyaluronic acid which can generally be divided into those which are of short duration, requiring injections

once a week, and those of long duration which remain for a longer period of time in the joint, making it possible to give a single injection which will last for a longer period of time, ranging from 6 to 12 months.

Side effects

The infiltration of HA is a safe technique if performed correctly and if carried out aseptically. However, it may cause slight, local side effects in 1-2% of cases, with particular mention of: skin redness, bruising, localised itching or local inflammation at the injection site which disappear in 1-3 days[51]. A few cases of pseudogout and chondrocalcinosis have also been described following administration of HA.

Contraindications

HA has the contraindications characteristic of intra-articular infiltration and for those patients that are hypersensitive to this substance. It is not recommended for patients with coagulation disorders and must be administered with caution in patients with severe lymphatic or venous insufficiency. Neither is it recommended for pregnant women or when breastfeeding.

Scelerosing agents

Sclerotherapy is a medical procedure consisting in introducing a chemical substance into the blood vessel lumen, causing vessel thrombosis and obliteration and secondary fibrosis. The most common scelerosing agents include polidocanol used for the sclerosis of neovessels formed in tendinosis[52-54], although others are also available (sodium tetradecyl sulfate, chromic glycerine, etc.) used in the sclerosis of other pathologies.

Indications

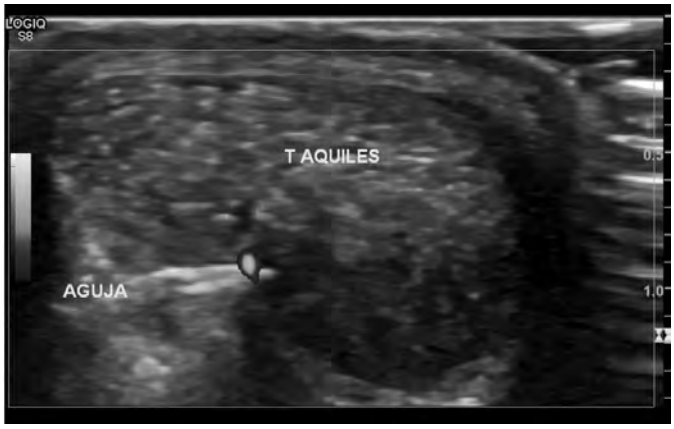
Sclerotherapy has many different applications, including the area of Sports Medicine, especially different types of tendinopathies. The use of sclerotherapy in tendinopathy is based on the demonstration that some tendinous injuries lead to the proliferation of small blood vessels in the areas of the tendons affected and the sensitive nervous fibres also proliferate around these neoformed blood vessels, being the cause of the pain (Figure 2). In theory, the injection of a scelerosing agent in the neovascularised areas provokes vascular sclerosis and, moreover, can eradicate the pain sensors[53-55].

At present, the results of sclerotherapy for Achilles tendinitis, epicondylitis, etc. are contradictory[3].

Adverse reactions

This drug rarely has any adverse effects. Sclerotherapy is a safe, well tolerated procedure. The undesirable effects at a local level include haematoma formation at the injection site, oedemas, temporary irritation (of the endothelial wall of the injected vein), slight pain at the injection site, hypopigmentation (in 10 to 30% of cases). Allergies appear only on rare occasions[54].

Figure 2. Sclelerotherapy technique for Achilles tendinitis. In this cross-section of the Achilles tendon, the point of the needle can be seen to reach the vessel to be scelerosed. Note that the needle chamfer is oriented towards the tendon.



Superficial thrombophlebitis or nodular fibrosis are not generally observed in operations of this type on small vessels, although there is the risk of thrombosis due to the incorrect administration of intravaricose injections.

Contraindicationss

By acting on small vessels, contraindications are almost limited to cases of known allergy to the scelerosing agent, although it is advisable to proceed with caution for patients with severe, acute disorders, a recent history of thrombosis or immobilised patients..

Bioregulators

Bioregulator drugs comprise active ingredients that are basically plant and mineral sourced, acting by stimulating the natural recovery mechanisms of the damaged tissue[56]. Compared to inflammation blocker drugs, bioregulators (Traumeel, Zeel, Spascupreel, etc.) are directed at modulating the inflammation. These bioregulators have been shown to inhibit the production and release of some pro-inflammatory cytokines[57-59].

Indications

Clinical and experimental studies have shown their beneficial effects in different sports injuries in relation to soft tissue (Figure 3) and chondral damage[60-62]. These injectable therapies can either be administered alone, concomitantly, or together with other drugs or techniques (physiotherapy, thermotherapy, RICE, etc).

Side effects

These substances have practically no side effects, with very good tolerability, although, in rare cases, there may be hypersensitivity or allergic reactions.

Figure 3. Fractured fibula of the straight femoral muscle. An examination of the short axis of this muscle shows a heteroechoic image (arrow) that blots out the intra-muscular wall, characteristic of a muscle tear with septum rupture.

Contraindications

In the event of allergy or hypersensitivity to these products or to any of their components, and for pregnant and breastfeeding women. As a precaution, it is advisable not to use these therapies for some systemic diseases (leukaemia, tuberculosis or autoimmune diseases), which require a different type of treatment.

Platelet-rich plasma

The last few years have witnessed the extended use of platelet-rich plasma (PRP) or the growth factors to accelerate the healing of many types of injuries. PRP is an autologous plasma that contains a greater concentration of platelets than normal blood. It was first used in the treatment of pathologies related to dentistry and maxillofacial surgery and this is the area with most experience.

Platelets transport substances in their granules and these influence the tissue repair processes. Following activation, they secrete a large quantity of growth factors (they can hold as many as 1100 active proteins) including the platelet derived growth factor (PDGF), beta 1 transforming growth factor (TGF-β1), platelet factor 4 (FP-4), vascular endothelial growth factor (VEGF), insulin-like growth factor 1 (IGF-1), epidermal growth factor (EGF), fibroblast growth factor (FGF), nerve growth factor (NGF), hepatocyte growth factor (HGF), etc. whilst an increase in the systemic levels of some of these factors such as IGF-1, FGF, and VEGF[63] have been observed. Many of these growth factors (GF) are active in the healing of different pathologies[32,64].

More than 30 different platelet concentration systems are available on the market, achieving different densities depending on the extraction, centrifugation, filtration methods, etc. However, at present, the platelet concentration offering the most beneficial effects has yet to be determined, neither is it known whether or not the presence of leukocytes in PRP is beneficial.

The greatest problem with this technique is that there are no clear criteria on how to prepare PRP, right from the blood collection up to the administration of the preparation. There is no consensus on the centrifugation speed and time, the activation of the PRP, which can be made either before or after administration to the tissue, on the volume of PRP to be applied, the frequency of application or the number of applications[65,66]. And, most importantly, the PRP content: the growth factors contained and those factors that are useful for the treatment of the injury and those that could be harmful.

Indications

There is an increasing number of articles on the role played by PRP in the treatment of chronic tendon injuries[3,67-70], articular cartilage injuries[71], ligament injuries[72], meniscus injuries[73], muscle injuries[74-77], etc.

In addition to the potential beneficial effects on soft tissue injuries, there are the bactericidal effects of the antibacterial and fungicidal proteins stored in the platelets (opsonophagocytosis), which may help to prevent infection[78]. In the future, it could be used in the prophylaxis of infections and, in particular, for surgical wounds. Furthermore, HGF is a potent antifibrotic agent and its secretion may help to reduce tissue scar formation.

The results on the effectiveness of this technique are extremely varied from one author to another. Some investigations show PRP to be effective and to accelerate the healing of certain injuries, whilst others show no benefit at all. This disparity of criteria may be due to the technique employed, the tissue treated, the type of injury[79-81], etc.

However, in most cases, with regard to sports injuries, there is little scientific evidence, and the evidence available is of poor quality.

Given the fact that, at present, the clinical results of infiltrations with PRP are extremely dubious[66,82] due to the poor methodological quality of most of the investigations published, and a lack of consensus, despite the fact that a consensus document was recently published[65], it would be necessary to conduct randomised clinical trials (RCT) on the use of PRP in the treatment of different sports injuries, and which include clear, specific protocols.

Side effects

There are no clear scientific reports to suggest possible side effects following the administration of PRP. At a local level, temporary inflammatory reactions may appear at the puncture site. Bearing in mind the fact that it is an autologous substance, in theory it ought not to provoke allergic or immunogenic responses or other harmful effects, and ought to be a safe and secure product[83,84]. However, if it contains bovine thrombin, then this could be a problem, and the latest techniques endeavour to avoid this substance.

PRP can improve the proliferation of mesenchymal stem cells and migration, yet it can also limit stem cell differentiation, although, for the time being, there are no references for side effects in this area[83].

Contraindications

PRP infiltrations are contraindicated in those cases with septicema or local infection at the infiltration site, neither should this treatment

be applied to patients with platelet dysfunction syndrome or thrombocytopenia.

As relative contraindications, we could cite patients either with cancer, a low platelet count or with a fever at the time of infiltration.

Prolotherapy

Prolotherapy, proliferation therapy or regenerative injection therapy (RIT) consists in the infiltration of substances that stimulate tissue regeneration and repair. The treatment is based on the infiltration of irritating chemical solutions with local anaesthetics around the injured structures, to allow for the increased resistance of the tissue and, secondarily, to reduce pain and disability[85].

Prolotherapy uses three types of substances: irritants, chemotactic agents and osmotic agents; Although the mechanism of action has not been clearly established, irritants (phenol, guaiac and tannic acid) produce direct cell damage, chemotactic agents (morrhuate sodium) generate an inflammatory response whilst osmotic agents (concentrated solutions of dextrose, glucose, glycerine or zinc sulphate) provoke the osmotic rupture of cells and an inflammatory response, releasing cytokines and growth factors that promote healing, improving the joint function and tissue recovery[86-88]. Hypertonic dextrose is the most commonly applied solution, because it is non-toxic, amongst other reasons.

Prolotherapy technique involves the administration of a small quantity of a specific solution at typical trigger points (ligaments, tendons, etc.). The solution is generally administered at 3 to 6 week intervals, with a total of four to eight sessions[89].

Indications

According to some investigations, it could be an alternative treatment in chronic pathologies of the locomotive system, such as back pain, sprains, tendinopathies, joint instability, ligament laxity, fibromyalgia, plantar fasciitis, sciatica, Osgood-Schlatter and osteoarthritis amongst others[32,87,88,90-92], although more studies are required in order to openly recommend this therapy[93].

Prolotherapy lessens pain according to some studies that have used the VAS (visual analogue scale)[94] and it also reduces locomotive disability.

Tendinopathy and myofacial pain syndrome improve clinically and functionally with prolotherapy[93,9-98].

Prolotherapy (dextrose) considerably reduces pain levels, thereby speeding up the resumption of sports activities in pathologies such as Osgood Schlatter[99,100].

Benefits have also been observed for meniscal degeneration[98].

For oastoarthritis and other degenerative joint pathologies, prolotherapy with dextrose produces a significant improvement in pain[101,102].

Side effects

Normally, there is a post-injection pain flare that can last from a few minutes to several days, but the discomfort is bearable. Headaches and dizziness have also been described, due to phenol, a potentially toxic substance. Therefore, treatment with dextrose alone is preferable[89,103]. When dextrose is used, significant adverse affects do not generally appear[87], and allergic reactions are uncommon.

Contraindications

Allergies to some of the infiltrated products, local infection at the treatment site, significant local inflammation, septic arthritis and significant coagulation disorders.

Other substances used

Autologous blood infiltrations. This is based on the same principles as PRP, given the fact that blood contains substances, including growth factors, which can modify cell activity. The technique is very simple, consisting in drawing some 2-3 cc of venous blood from the patient, with subsequent local infiltration at the pathological site. Anything from one to three autologous blood infiltrations can be applied, with an interval period of 1-2 months.

It is basically used in the treatment of tendinopathies, although the results are contradictory[104-108].

Non-steroidal anti-Inflammatory drugs. NSAIDs are the most commonly used drugs in the treatment of most sports injuries and, although the oral route is the one that is most frequently used, they are also administered by the injectable route. For tendon injuries with no inflammatory component, these drugs are merely pain relievers and, as such, their administration is the subject of much discussion[36,109,110]; this is also the case for muscle injuries. For acute sprains, they have an analgesic and anti-inflammatory effect, whilst they are also prescribed for this same reason following surgical operations[111,112].

Stem Cells, Growth Factors and Related Therapies. Although they are now part of the present, stem cells and related therapies will form part of the therapeutic arsenal for sports injuries and other locomotor system disorders.

Until now, most growth factors have been studied in vitro and on test animals, yet this is a therapy with a great future given the fact that the specific growth factors of the tissue to be treated would be introduced into the damaged site.

For their part, stem cells provide very important immunomodulating activity with regard to tissue repair and, in particular, for tendon, chondral, muscle and ligament pathologies, they have great therapeutic potential[32,113,114].

Botulinum Toxin. Type A botulinum toxin is a neurotoxin that inhibits the release of the neurotransmitter acetylcholine at the neuromuscular junction, provoking the temporary paralysis of the skeletal muscle and, secondarily, a reduction in pain. Some trials have been conducted on its application in some injuries such as epicondylitis and, in general, it can be said that improvement is questionable[3,115,116], and could be used as a final treatment option, although more robust studies are required to demonstrate its effectiveness[32].

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Recommendations for adult sport athletes with congenital heart diseases

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Received: 15.12.2015
Accepted: 09.03.2016

Summary

Safety of sport and physical activity in adult patients with congenital heart disease is still not well established. Recommendations on exercise in this subgroup of patients are usually pretty restrictive without having clear evidence for this, even though sport has shown significant cardiovascular benefits in both the general population and in patients with cardiovascular problems. Prevalence and survival of this population has increased considerably in recent decades due to early diagnosis, a substantial improvement in therapeutic measures, both surgical techniques and percutaneous, as well as aftercare and strict long term clinical monitoring. This is why it is increasingly common to find asymptomatic patients with good performance status and many doubts about their chances in sports. Doubts among professionals in establishing the best recommendations in relation to sport also arise. In the last years, it has become particularly relevant the study of the benefits and safety of these types of activities in this subgroup of patients. Researches focuses mainly on the safety of physical activity in patients with congenital heart disease, and fear that the practice of physical activity on a competitive level can significantly increase the risk of adverse events, especially arrhythmic events and sudden death. In this review, we analyzed numerous studies and current clinical practice guidelines, in order to establish recommendations for physical activity and its restrictions in terms of the different types of congenital heart disease.

Key words:
Exercise.
Congenital heart disease.
Sporting activity.
Competition.

Recomendaciones para la actividad deportiva en atletas con cardiopatías congénitas en el adulto

Resumen

La seguridad de la actividad física y deportiva en pacientes adultos con cardiopatías congénitas aún no está bien establecida. Las recomendaciones sobre el ejercicio físico en estos pacientes suele ser bastante restrictiva sin que haya clara evidencia para ello, a pesar de que el deporte haya demostrado importantes beneficios cardiovasculares tanto en la población general como en estos pacientes. La prevalencia y la supervivencia de esta población ha aumentado considerablemente en las últimas décadas debido a un diagnóstico precoz, una sustancial mejora de las medidas terapéuticas, tanto en técnicas quirúrgicas como percutáneas, así como en los cuidados posteriores y un seguimiento clínico estricto a largo plazo. Es por ello que cada vez es más frecuente encontrarnos con pacientes asintomáticos con buen grado funcional y con numerosas dudas sobre sus posibilidades en la práctica deportiva. Así mismo, surgen dudas entre los profesionales a la hora de establecer las mejores recomendaciones en relación a la actividad deportiva. En los últimos años ha cobrado especial relevancia el estudio de los beneficios y la seguridad de este tipo de actividades en este subgrupo de pacientes. Las investigaciones se centran fundamentalmente en la seguridad de la actividad física en pacientes con cardiopatías congénitas, y el temor a que la práctica de actividad física a nivel competitivo pueda aumentar significativamente el riesgo de eventos adversos, especialmente de eventos arrítmicos y muerte súbita. En esta revisión, analizamos numerosos estudios y las guías de práctica clínica actuales, con el fin de establecer las recomendaciones de actividad física, así como sus restricciones en función de los diferentes tipos de cardiopatías congénitas.

Palabras clave:
Ejercicio físico.
Cardiopatías congénitas.
Actividad deportiva.
Competición.

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Introduction

Today, clinical care for children with congenital heart diseases, as well as advanced surgical techniques, have given way to a considerable increase in the survival rate of patients who reach adulthood. Despite this, only a minority of patients with congenital heart disease (approximately 19%)[1] receive advise on recommended physical activity and they often follow a sedentary lifestyle, as a result of overprotection and uncertainty regarding the type and intensity of physical activity they should carry out. This is of particular importance when considering the trend within this demographic to become overweight, in comparison to the general public, fundamentally due to a lack of physical activity[2].

The participation in sports by adults with congenital heart diseases is considered a relatively new field, and many doctors may face difficulties when advising their patients. The main concern is based on patient safety and the fear that carrying out sports to a competitive level may increase the risk of adverse events, especially arrhythmias and sudden death. However, within this field there is a significant lack of prospective data, and there are still many disputed opinions. Moreover, it should be remembered that participation in sporting events might have beneficial effects on life quality, ischemic heart disease and heart failure[3]. As a result, we should not limit, above indicated levels, physical or recreational activity. Studies carried out on patients with congenital heart disease indicate that the majority of people participating in training programmes and receiving appropriate recommendations reveal a significant improvement in their exercise capacity and psychological state. The current challenge is to ensure safe participation in regular physical activity in order to avoid the detrimental effects associated with a sedentary lifestyle. This article describes recommendations for physical activity depending on the different type of congenital heart disease. Below is a classification of the static and dynamic components of the currently most practised sports (Table 1)[4].

Bicuspid aortic valve

The bicuspid aortic valve (BAV) is the most common congenital heart disease within the general population, with an incidence rate of around 0.5-2.4%, with higher prevalence in males. This may often be associated with certain anomalies, such as narrowing of the aorta, ventricular septal defects or obstruction of the left ventricular outflow tract. The prevalence among athletes is still little known, though literature describes how there may be a similar incidence rate as that of the general population[5].

Despite the majority of cases being sporadic, an important family burden has been identified, with a BAV incidence rate between 10 and 17% in first-degree family members[6]. This is why it is important to carry out a good anamnesis and a more thorough study on athletes with BAV family antecedents.

The presence of bicuspid aortic valve does not usually present an obstacle when it comes to initiating sporting activity; however, the impact of high-intensity training on the heart of an athlete is unknown. In theory, the physiological stress of intense and on-going exercise on an abnormal aortic valve may cause its early deterioration and dilatation of the ascending aorta[7]. This is why early identification in these athletes may help in the follow-up and prevention of adverse consequences that may arise from intense training by these carriers.

This is particularly important if we consider that the majority of these athletes have absolutely no symptoms whatsoever, with the first symptoms emerging after 40 years of age. In most countries, the pre-participation screening protocol carried out includes an appropriate anamnesis and complete physical examination, including cardiac auscultation.

However, if the BAV is not associated to stenosis or heart failure, its diagnosis via auscultation is highly unlikely. This is why performing a transthoracic echocardiogram (or transesophageal echocardiogram, which is more sensitive) is a fundamental tool in detecting the presence of BAV, however, it is not carried out routinely.

Table 1. Classification of sports depending on cardiovascular needs (based on combined static and dynamic components) adapted to sports carried out in Spain.

Sports	Low dynamic	Moderately dynamic	Highly dynamic
Low static	Billiards, Bowling, Golf, Throwing	Baseball, Softball, Table tennis, Tennis (doubles), Volleyball	Badminton, Cross-country skiing (classic), Grass Hockey[a], Orienteering, Running, Athletics (long-distance), Football[a], Squash Tennis
Moderately static	Archery, Motor racing[a,b] Diving[a,b], Horse riding[a,b], Motorcycling[a,b]	Fencing, Athletics (jumping), Figure skating[a], American Football[a] Rugby[a], Athletics (speed) Synchronised swimming[b], Surfing[a,b]	Basketballa, Ice Hockey[a], Cross-country Skiing (skating), Athletics (middle-distance) Swimming, Handball
Highly static	Athletics (throwing) Gymnastics[a,b], Karate/Judo[a] Sailing, Rock climbing[a,b] Water skiing[a,b], Weightlifting[a,b] Windsurfing[a,b]	Bodybuilding[a,b] Wrestling[a]	Boxing[a] Canoeing, Cycling[a,b], Athletics (Decathlon), Speed skating, Rowing

[a]: danger of corporal collision; [b]: increased risk in the event of a syncope.

The most frequent complications associated with BAV are: aortic stenosis (15-51%), heart failure (7%), endocarditis (5%) and aortic dissection (4-5%)[8].

The bicuspid aortic valve is also considered to be an independent cause of aortic dilatation. Given the high prevalence of BAV among the general population, this represents the most common aetiology of aortic dilatation, and eventually dissection. In cases of BAV with coexisting ascending aorta dilatation, intense physical exercise may lead to a significant risk of aortic dissection or rupture, especially during isometric exercises. In fact, during phases of high-intensity competition, it may even induce major arterial hypertension, which stimulates the appearance of these complications. The presence of BAV significantly increases the risk of dissection, especially among young and previously asymptomatic patients.

This risk increases considerably when the aortic diameter is greater than 50mm and in the presence of accompanying arterial hypertension (AHT).

According to the Clinical Practice Guides of the Spanish Cardiology Society regarding physical activity performed by the heart disease patient, in the evolution of this disease an ECG must be performed along with an echocardiogram to establish the severity of the valvular heart disease. In cases of aortic stenosis, a distinction is made between the mild forms (< 20 mmHg), moderate forms (21-49 mmHg) and severe forms (>50 mmHg), based on the peak systolic gradient measured with an echocardiographic Doppler[9].

Likewise, anyone with BAV wishing to practise competitive sports is recommended to carry out a stress test before starting the physical activity, and a Holter monitor to improve the risk stratification and to suitably establish the intensity of the exercise.

Prescribing physical and sporting activity in aortic stenosis[10]:

- Mild: no limitations on physical activity or competitive sports.
- Moderate:
  - Physical activity: mild intensity: allowed. Intense: prohibited.
  - Competitive sports: Mild intensity: allowed with low static charge and low or moderate dynamic charge and with moderate static charge and low dynamic charge. Intense: prohibited.
- Severe:
  - Physical activity: mild intensity: allowed. Intense: prohibited.
  - Competitive sports: prohibited.

Prescribing physical and sporting activity in aortic insufficiency[10]:

- Mild: no limitations on physical activity or competitive sports.
- Mild-moderate: with normal ECG without Left Ventricular (LV) dilatation:
  - Physical activity: no limitations.
  - Competitive sports: mild intensity: allowed. Intense: allowed if the stress test is normal.
- Moderate-serious, with alterations in the ECG and LV dilatation:
  - Physical activity: mild intensity: allowed. Intense: prohibited.
  - Competitive sports: prohibited.

The cardiac stress test is recommended to asymptomatic patients that wish to practise competitive sports. These athletes, despite having a very low sudden death incidence rate, may suffer from this especially in very serious cases in relation to exercise-induced ischemia; in these cases performing the stress test is clearly contraindicated. Patients that have undergone effective valvular repair, with no residual gradient or with a minimum residual gradient, should wait for at least 3 months after the percutaneous valvuloplasty or 6 months after surgery before returning to sporting activities.

The presence of at least one of the following criteria may be considered to be associated with a greater cardiovascular risk in patients with bicuspid aortic valve[11]:

- Aortic systolic gradient > 20mmHg.
- Aortic root dilatation (diameter > 40mm).
- Moderate-severe heart failure.
- LV dilatation (LVD 60 mm) connected to symptoms (syncopes, prolonged palpitations) or arrhythmias, such as supraventricular or ventricular tachycardia documented on the ECG or electrocardiographic monitoring.

In a study performed by the National Institute of Sports Medicine in Rome in 2006[12], 8000 patients were assessed, among which 81 had BAV. In this study, athletes with none of the previously described criteria were classified in a low-risk group, and were considered apt for competition. However, the patients that presented at least one risk factor were discouraged from participating in training and competition. In the 13-year follow-up of the patients at low risk (the high-risk patients were excluded), 12% presented some kind of complication (aortic root dilatation, increase in gradient, arrhythmic events, etc.) and were moved into the high-risk group. In conclusion, this study reveals the importance of undergoing strict follow-up of these patients, as well as their high probability of presenting an unfavourable clinical evolution.

The clinical and prognostic course of athletes with bicuspid aortic valve still remains uncertain. However, numerous studies suggest that with competing athletes, the BAV should not simply be considered to be a variation of normal, rather a possible association with a worsening of the valve morphology and functioning, as well as clinical deterioration.

Given the high prevalence of aortic valvular pathology and other potential risks that this entails in athletes subject to high levels of sporting activity, it is recommended to expand the pre-participation cardiovascular study to identify and adjust the stratification in athletes with BAV. It can be confirmed that practising high-level sport is not in itself the cause behind the deterioration of this disease; however, some results have revealed that long-term training may be associated in some individuals with a progressive worsening of valvulopathy, aortic root dilatation and the appearance of clinical symptoms.

Left-right shunts

Atrial Septal Defect (ASD) and Ventricular septal defect (VSD)

The most common defects with left-right shunts are ASD and VSD, and patent ductus arteriosus. In these diseases, oxygenated arterial

blood passes to the venous side, causing an overload in volume of the cavities through which the excess blood passes, including the lungs, also potentially causing major pulmonary hypertension (PHT).

Its detection requires clinical diagnosis, an x-ray of the thorax, electrocardiogram and echocardiogram. It may be considered to be both lung pressure as well as a shunt (pulmonary/systemic flow relation (Qp/Qs)) via the echocardiogram; however, these measures are best established via catheterisation, if considered necessary.

With regards to atrial septal defect (ASD), the majority of patients are asymptomatic till adulthood. However, a large proportion of them develop symptoms from the age of forty: reduced functional capacity, dyspnoea related to efforts, palpitations, and right cardiac failure… Occasionally, cases can be seen of secondary pulmonary hypertension with overloading in right cavities, especially in older patients, or in shunts that have gone unnoticed for a long time.

In terms of performing exercise, no clear restrictions have been established for asymptomatic patients before or after intervention, always in the event that they do not have pulmonary hypertension, major arrhythmias or right ventricular dysfunction. In patients with severe pulmonary hypertension or Eisenmenger Syndrome (inversion of the shunt), physical activity or recreational sports should be limited to those of medium-low intensity[13].

In ventricular septal defects, there are similar restrictions to those previously mentioned for atrium defects. There are no limitations for patients following the closure of this shunt with restricting VSD of small size, without PHT, arrhythmias or right ventricular dysfunction. Patients with PHT may limit themselves to low-moderate intensity activities or sports for non-competitive purposes.

Physical and sporting activity in left-right shunt defects

- Small or moderate (Qp/Qs<2) with normal pulmonary pressure:
  - Physical activity: no limitations.
  - Competitive sports: no limitations.
- Large (Qp/Qs >2): with normal or slightly elevated pulmonary pressure:
  - Physical activity: no limitations.
  - Competitive sports: Mild intensity: low-charge static and dynamic sports allowed. Intense: prohibited.
- With pulmonary hypertension:
  - Physical activity: Mild intensity: allowed. Intense: prohibited.
  - Competitive sports: Mild intensity: allowed if the stress test is normal. Intense: prohibited.
  - Both prohibited if it is Eisenmenger Syndrome.

Following the correction of inter-atrial and inter-ventricular septal defects (this may be performed using conventional surgery or percutaneously), specially targeted recommendations should be followed if there is residual defect, as well as pulmonary hypertension. Furthermore, it should be remembered there are other possible limiting factors to exercise, such as the appearance of arrhythmias and ventricular dysfunction. For these patients the recommendation is to avoid sporting activity for at least 6 months following the intervention[14].

In general, for mild residual defects, no limitations are set for physical exercise or competitive sport. However, with moderate-serious defects, intensive sport is contraindicated, though low-intensity sport can be performed. Moreover, it is recommendable to perform an ergometer on patients that still display signs of pulmonary arterial hypertension, symptomatic arrhythmias or ventricular dysfunction after 6 months following intervention.

Patent ductus arteriosus

Patent ductus arteriosus (PDA) is defined as the persistent communication between the pulmonary artery (predominantly the left pulmonary artery proximally) and the descending aorta (just distal to the outflow left subclavian artery). On numerous occasions, it may be associated with other congenital heart diseases; however, in adulthood the presence of PDA is usually an isolated cardiac finding.

The majority of patients with this pathology are usually completely asymptomatic, with small-sized ductus that does not affect the cavities, or significant pulmonary hypertension. However, on some occasions there may be secondary impacts to this shunt: overloading of the left cavities, with dilatation or accompanying ventricular dysfunction, pulmonary hypertension, Eisenmenger physiology... There is also a potential risk of endarteritis, though this seems to be rare. The formation of aneurisms in the ductus level is a very rare complication, and may compress the left coronary tree. The suspected diagnosis is usually performed with an echocardiograph, though a CAT scan or MR is recommended to establish a confirmed diagnosis and to quantify and more precisely define the anatomy of the ductus.

In terms of performing sporting activity, there are no restrictions in place for asymptomatic patients either before or after intervention; the only limitation is to practise low-intensity sports when pulmonary hypertension is detected[15]..

Permeable ovale foramen

The persistence of a permeable ovale foramen (POF) in adults is a common condition, with a prevalence of approximately 25% of the general population. In the majority of cases, the presence of POF is a casual finding with no clinical repercussions; however, the link between POF and clinical conditions has been frequently described in POF association literature, such as embolic cerebrovascular accidents, platypnea-orthodeoxia syndrome, gas embolism, or migraines.

In terms of athletes, a special mention should be given to divers, among whom major complications may arise such as gas embolism. Decompression syndrome is a term used to name the gas embolism produced, especially in divers and pilots, due to a rapid drop in atmospheric pressure, which leads to a reduction in the solubility of gases and the possible release of these gas bubbles into the blood stream[16].

Diagnosis of POF is made by performing a transthoracic echocardiogram with/without bubbles, and a transesophageal echocardiogram.

Regarding the treatment of choice for POF, today there is still no clear definition; there are no specific recommendations for athletes as opposed to the general public carrying POF. However, there are some specific clinical situations, such as recurring cryptogenic ictus in young patients (<55 years) with evidence of venous thrombosis or high-risk anatomies, in which the percutaneous closure may be justified[17]. Likewise, the percutaneous approach has become the treatment of choice among patients with platypnea-orthodeoxia and requires the closure of the atrial septal defect18. In these patients, the percutaneous shunt closure has proven to be safe and effective, with a success rate of around 86-100%[19].

Coarctation of the aorta

Coarctation of the aorta is one of the most common congenital heart diseases, making up between 5 and 8% of congenital heart defects. It can occasionally be treated as an isolated defect, though in over 60% of cases patients present some kind of accompanying pathology: bicuspid aortic valve (30-40%), sub-valvular or aortic supra-valvular stenosis, complex congenital heart diseases or Turner Syndrome.

Diagnosis of coarctation is defined as the narrowing of the intraluminal calibre that causes an obstruction to the aortic flow. In the majority of cases, the coarctation area is usually localised in the descending thoracic aorta distal to the outflow left subclavian artery with different degrees of extension, and in some cases is associated with hypoplasia of the aortic arch. Diagnosis of coarctation should be suspected in young patients with refractory hypertension and weakness or an absence of pulses to the lower limbs.

To diagnose and follow up coarctation of the aorta, a good anamnesis is needed, such as an electrocardiogram, an echocardiogram, and occasionally, an ergometer. However, performing a CAT or MR scan of the thorax is a key tool in establishing a definitive diagnosis for these types of diseases. When the coarctation is mild, all kinds of physical or sporting activities can be carried out. However, when the coarctation is major or the stress test reveals the presence of serious systematic arterial hypertension in connection with the exercise, only low static and dynamic component sports can be carried out[20].

Anatomical correction may be performed using conventional surgery or percutaneously with dilatation and posterior implant of a stent at the level of the coarctation. Following intervention, sporting activity will depend on the presence of residual gradient. It is recommendable to wait approximately 6 months following the intervention before starting sporting activity. It is recommendable to avoid sports with high static charge and contact sports for the first year after surgery. After this first year, any kind of sport is permitted except for weightlifting. However, if an aneurismatic area or aortic dilatation persists as a residual injury, exercise will be restricted to low static and dynamic component activity.

Physical and sporting activity in the coarctation of the aorta

- Base gradient between 10 and 20 mmHg:
  - Physical activity: no limitations.
  - Competitive sports: mild intensity: allowed. Intense: allowed if the ergometer is normal.
- Base gradient higher than 20 mmHg:
  - Physical activity: mild: allowed. Intense: allowed with low static and dynamic component.
  - Competitive sports: allowed with low static and dynamic component.
- Base gradient higher than 50 mmHg:
  - Physical activity: mild intensity: allowed. Intense: prohibited.
  - Competitive sports: prohibited.

To conclude, patients without residual obstruction that are normotensive both resting and during exercise, may carry out unrestricted sporting activity, except for sports with a high static component. On the other hand, patients with AHT, significant residual obstruction or other complications, should avoid high-intensity isometric exercises in proportion with the severity of their pathology[10].

Marfan Syndrome

Marfan syndrome is a dominant autosomal hereditary disease that generates an alteration of connective tissue, causing an impact on various levels: cardiovascular, ocular, muscular-skeletal or pulmonary. It has an estimated prevalence of around 1 in each 5,000 live new-borns[21].

Cardiovascular manifestations pose a particular interest because they entail a high risk of sudden death in individuals with this condition. The most frequent manifestations are dilatation of the aortic root, mitral valvular prolapse, coarctation of the aorta or ASD. On the other hand, the worst finding is aneurism or aortic dissection. Approximately 60% of patients with Marfan syndrome have aortic root dilatation, predominantly males. In general, medical treatment for these patients is based on avoiding aortic root dilatation and dissection by aiming to reduce arterial pressure and cardiac inotropes. Treatment with beta-blockers[22] has been widely recommended in numerous studies with the aim of avoiding the progressive dilatation of the aorta. Moreover, recent studies have further investigated the use of ARB II (angiotensin receptor blockers II) to inhibit TGF-B signals that are involved in the dilatation of the aortic root in Marfan syndrome.

Currently, the criteria reviewed by Ghent are used to diagnose Marfan syndrome (Table 2)[24]. The main tools used to assess the cardiovascular impact are performing transthoracic echocardiogram and the CAT/MR scan of the thorax. Stable patients require annual check-ups with an echocardiogram. The use of a CAT/MR scan is recommended every 5 years if there is no aortic dilatation; in the case of aneurism or aortic dilatation, these image tests should be repeated annually[25].

Given the higher level of vulnerability patients with this disease face, limits for intervention and surgery are different to those of the general population. With regards to surgical repair, according to 2014 European guidelines regarding the diagnosis and treatment

Table 2. Diagnostic criteria of the Gante nosology for diagnosing Marfan syndrome

Organ/System	Requisites for classifying the major criteria	Requisites for the impact on the organ/system
Skeletal	At least four of the following: 1. Pectus carinatum 2. Pectus excavatum requiring surgery 3. Ratio between segments reduced or ratio size and height elevated (<1.05) 4. Thumb and wrist signs positive 5. Scoliosis (20º) or spondylolisthesis 6. Reduced elbow extension (<170º) 7. Medial displacement of the internal malleoli causing flat foot. 8. Acetabular protrusion	At least two findings for major criteria, or one from this list and two from the following minor criteria: 1. Moderately severe pectus excavatum 2. Joint hypermobility 3. Palate with pronounced arch or dental crowding 4. Characterised facial appearance (dolichocephaly, hypoplasia malar, enophtalmos, retrognatia, low palpebral fissure)
Ocular	Ectopia *lentis*	At least two of the following minor criteria: 1. Abnormally flattened cornea 2 Increase of axial length of the eyeball 3. Hypoplasia of the iris or Ciliary muscle, causing reduced miosis
Cardiovascular	At least one of the following: 1. Dilatation of the ascending aorta with or without regurgitation, affecting the Valsava sinuses 2. Dissection of the ascending aorta	At least one of the following minor criteria: 1. Prolapse of the mitral valve, with or without regurgitation 2. Dilatation of the pulmonary artery, in absence of stenosis or another cause in individuals under 40 years 3. Dilatation or dissection of the descending or abdominal thoracic in individuals under 50 years
Pulmonary	None	At least one of the following minor criteria: 1. Spontaneous pneumothorax 2. Apical bullous
Teguments	None	At least one of the following minor criteria: 1. Marked stretch marks in the absence of important weight variations, pregnancy or repeated stress 2. Recurring or incisional hernia
Hard	Lumbosacral dural ectasia	None

To diagnose Marfan syndrome in patients without family antecedents of the disease, two organs/systems should be involved that bring together the criteria and at least an impact on a third organ/system. In patients with a family history of Marfan syndrome, only one major criterion is required, with data that suggests an impact on a second system (De Paepe, *et al*).

of the pathology of the aorta[26], surgery is recommended to patients with Marfan syndrome and with a maximum aortic diameter that is greater or equal to 50 mm, or 45mm if there are risk factors, such as family antecedents of dissection, growth > 3mm/year (in various exams using the same technique and with confirmation in another), serious aortic regurgitation or the intention to become pregnant. Patients with Marfanoid manifestations through disease of the connective tissue, without complete Marfan criteria, must be treated as Marfan patients.

With regards to the participation of athletes with Marfan syndrome, the most important aspect to consider is the early detection of athletes with this condition. Athletes with a marfanoid phenotype or family antecedents should be examined immediately to rule out this pathology, prior to initiating sporting activity. More aggressive screening strategies are recommended for sports that typically involve athletes with this specific profile and with certain marfanoid habit, such as basketball and volleyball. The prevalence of Marfan syndrome is usually higher within this demographic, which is why screening these high-risk groups may improve the early detection of this pathology and avoid the progression of this disease among these athletes[27].

Today, significant restrictions are in place regarding physical activity performed by Marfan syndrome patients. For example, activities that involve collisions or intensive contact sports are considered to be particularly high risk for these individuals, given the cardiovascular and skeletal susceptibility that these individuals present. Likewise, athletes carrying this syndrome should not carry out high-risk activities, or at least they should aim to minimise their exposure to these kinds of activities.

In regard to current recommendations, isometric exercises should be prohibited for athletes with Marfan syndrome, given the damaging haemodynamic effects of straining the aortic wall, which produce a significant increase in the risk of aortic dissection or rupture. According to that established in the 36th Bethseda Conference[28], these athletes should only participate in low-intensity activities and with a low dynamic and static component (such as hiking, bowling, golf, etc.).

Congenital coronary anomalies

Congenital coronary anomalies present major implications for athletes. These anomalies have been described in around 1% of the general population[29]. This incidence rate is usually underestimated, given that the majority of cases proceed asymptomatically and the condition can be undetectable. Furthermore, it has not yet been clarified whether the rate of coronary anomalies in athletes is different to that of the general population; however, currently there are numerous studies underway based on screening and autopsies, which aim to confirm whether or not prevalence among athletes is greater than among the general population.

In a recent review of coronary anomalies, researchers classified them into four different groups:

- Anomalous source and course,
- Anomalous intrinsic coronary arterial anatomy,
- Anomalous coronary termination, and
- Anomalous anastomotic vessels[30].

Numerous image methods have been used to diagnose coronary anomalies, including conventional coronary angiography, transthoracic echocardiogram, transesophageal, multi-cut CAT scan and thorax MR. This group of diseases has frequently been diagnosed using a coronary catheterisation; however, despite the efficiency of this technique when it comes to detecting the source and final course of coronary arteries; these are limited as they do not give a view of the spatial orientation of the coronary arteries in relation to other intra-thoracic structures involved in coronary arterial anomalies.

The importance of diagnosing this pathology in athletes is particularly based on the significant increase in the risk of sudden death resulting from this condition. In the United Kingdom, this constitutes the second most frequent cause of sudden death in athletes[31]. Occasionally, sudden death can be the first manifestation of the process in athletes, with no previous episodes of angor ever appearing with strain or other symptomatology.

The anomalous source of the left coronary artery in the right Valsalva sinus and the anomalous source of the right coronary artery in the left coronary sinus are the most frequent coronary anomalies associated with the risk of sudden death in athletes. Despite the lower incidence rate, the presence of one coronary artery has also been associated with an increased risk of sudden death during exercise.

The general mechanism of death in these athletes is produced through coronary ischemia and ventricular arrhythmias. However, the precise mechanism of this pathology is still unknown and may be different depending on the structural anomaly.

As we have previously mentioned, the main concern in the diagnosis and follow-up of coronary anomalies is fundamentally the high risk of sudden death. In accordance with recommendations from the 26th Bethseda Conference, detection of these abnormalities should entail the exclusion from participation in any competitive sport, although surgical treatment (if possible) significantly reduces the risk of sudden death. Likewise, participation in sporting activity could be allowed from six months following surgery, always as long as a maximal stress test has been carried out beforehand with no evidence of induction of ischemia[32].

To conclude, the basic recommendation for athletes with coronary anomalies is non-participation in competitive sports, unless reparation or surgical intervention is performed. In the most common types of coronary anomalies described above, excision and reintroduction is usually performed, which involves repositioning the coronary arteries in the correct Valsalva sinuses. In cases where the coronary anomalies proceed with an intramural trajectory between the pulmonary artery and the aorta, an intracoronary stent implantation may be performed to treat this anomaly[33]. Moreover, a coronary artery bypass implant can be performed, though given the associated risks with these procedures, these are not routinely recommended for young active athletes.

Currently, preliminary studies reveal promising evidence that these techniques are effective. Literature on the subject describes an important series of cases involving post-operative patients demonstrating the absence of signs of ischemia during exercise based on symptoms, a basal electrocardiogram and a stress test, in a 2-year follow-up after surgical intervention. Likewise, today there is a drive to confirm the effectiveness of these procedures in protecting athletes from presenting a high risk of sudden death in a long-term follow-up.

Cyanotic congenital heart diseases

In general, patients with cyanotic congenital heart disease present diverse degrees of arterial desaturation and intolerance to exercise, making it highly unlikely they will be able to participate in any kind of sporting activity. However, in cases where there is capacity to carry out physical exercise, they will only be recommended sports with a low static and dynamic charge, taking into account that with strain the hypoxemia will increase even further in comparison to basal conditions. In alleviated cases, in which there is an on-going increased pulmonary flow, there is frequently a certain degree of arterial desaturation, meaning that only low static and dynamic component exercises can be performed, as long as the patient is asymptomatic and the hypoxemia is mild. In dubious cases, especially when it comes to light sporting activities, it would be recommendable to perform a stress test to analyse desaturation with the exercise. Below is a description of recommendations for sporting activity in some of the most frequent cyanotic congenital heart diseases.

Tetralogy of Fallot

Tetralogy of Fallot is the most common congenital heart disease after one year of life, with an approximate incidence rate at around 10% of these heart diseases. Diagnosis of this pathology consists in the association of these four elements: infundibula pulmonary stenosis (obstruction of the right ventricle outflow tract), ventricular septal defect, overriding ascending aorta (overriding aorta) and right ventricular hypertrophy. On occasions, these patients may also present associated atrial septal defect.

The majority of these patients require surgical treatment in their first years of life. This treatment has two tracks: one palliative and the other corrective. The first consists in performing a Blalock Taussig fistula (systemic-pulmonary), which connects the right subclavian artery with the right pulmonary artery and thus improves oxygenation. Corrective treatment is more used more nowadays and is principally based on unblocking the right ventricle outflow tract, closing the ventricular septal defect with Dacron patches and performing a correct alignment of the aorta.

In principle there are no restrictions on sporting activities in asymptomatic patients with good functional capacity. However, patients at high risk of arrhythmias or sudden death (numerous cases of sudden death have been described in patients with this pathology), or that present other complications such as bi-ventricular dysfunction, major residual pulmonary failure, or the advanced pathology of the ascending aorta, should limit their sporting activity to exercises with a low static and dynamic component, and should avoid performing isometric exercises34. Prior to this, the patient needs examining with an electrocardiogram, echocardiogram, Holter monitor and stress test.

Transposition of the great arteries

LTransposition of the great arteries comprises 5% of the cyanotic congenital heart diseases and is characterised by a ventricular-arterial discordance: the right ventricle connects to the aorta, whilst the left ventricle connects to the pulmonary artery. When there is also atrial-ventricular discordance, it becomes a transposition of the great arteries corrected congenitally. If there are no other associated cardiac malformations, it is a simple transposition; whereas complex transpositions often present different types of associated malformations: ventricular septal defect, obstruction of the outflow tract, coarctation of the aorta… The majority of adults are seen after undergoing surgical interventions in their childhood.

With regards to carrying out sporting activity, patients with an excellent haemodynamic capacity may perform regular activity, aiming to avoid extremely intense activities. However, patients that present worse functional capacity should limit their sporting activity and avoid contact and high-charge sports; they should be advised to perform regular low-mid intensity physical activity. Carriers of this pathology with symptoms or with a history of previous arrhythmias should be thoroughly assessed individually, given the high risk of exercise-induced arrhythmias. To do so, these patients are recommended to undergo a stress test, a Holter monitor and a transthoracic echocardiogram[35].

In the case of physiologically corrected transposition of the great arteries using Mustard or Senning surgical techniques, given that the morphologically right systemic ventricle develops long-term major ventricular dysfunction, low static and dynamic component sports are recommended. In any case, each case should be considered independently depending on the degree of systemic ventricle dysfunction.

The anatomical repair of the D-transposition of the great arteries (Jatene operation) has become the procedure of choice for surgical correction. Given that with this surgery normal anatomy is recovered, in principle, patients can perform all kinds of sports, as long as they present an optimal haemodynamic situation and that there are no residual injuries where the anastomosis took place[36]. Likewise, due to the diversity of the anatomy of the coronary arteries in the TGA and the need to reposition them in the Jatene operation, the appearance of a coronary ischemia is always assessed in these patients. However, it is recommendable to abstain from performing high static charge exercises, which may significantly increase arterial strain.

Patients following Fontan surgery

Patients with functionally uni-ventricular hearts undergo a series of interventions that aim to passively direct the flow of the systemic veins to the pulmonary circulation, leaving the one ventricle to drive systemic circulation, which is known as a Fontan situation or physiology.

Following a Fontan correction type for a uni-ventricular heart or for complex heart diseases, it is common for a certain degree of intolerance to exercise to persist, such as the appearance of early or late arrhythmias. Only patients with normal ventricular function, an absence of hypoxemia, absence of arrhythmias and a good tolerance of exercise proven using a stress test, may perform low static and dynamic charge exercises, with others not recommended. In general, these patients should only be recommended to perform recreational-purpose sports[37].

Physical and sporting activity in cyanotic congenital heart diseases

- Not corrected:
  - Competitive sports: prohibited.
  - Physical activity: Mild intensity: allowed with low static and dynamic component. Intensive: prohibited.
- Corrected:
  - Competitive sports: Mild intensity: allowed if the ergometer is normal and the patient is asymptomatic. Intensive: prohibited.
  - Physical activity: Mild intensity: allowed if the patient is asymptomatic and the hypoxemia mild. Intensive: prohibited.

Ebstein's anomaly

Ebstein's anomaly is a rare congenital heart disease, characterised by a malformation and apical displacement of the different tricuspid valve leaflets. The apical displacement of the tricuspid valve means that the right part of the heart is basically made up of the right atrium, an atrialised portion of the right ventricle and the residual region of the right ventricle, which generally functions normally. It is common to find that these patients also suffer from tricuspid insufficiency, which can occasionally be major.

The most common associations usually displayed in patients with this anomaly are: atrial septal defect (especially ostium secundum type ASD and permeable ovale foramen) and the presence of accessory pathways, given that many of these patients present Wolf Parkinson White syndrome[38].

In terms of practising sporting activity, patients carrying this malformation with no residual anomalies, may perform unrestricted physical activity, except for high static charge sports at a competitive level. However, patients experiencing heart complications, such as moderate-severe tricuspid insufficiency, shunt, right ventricular dysfunction or arrhythmias, should avoid intensive isometric exercises, in proportion to the severity of their pathologies.

Conclusion

It has been proven that practising exercise is beneficial in health adults as well as in patients with acquired cardiovascular diseases (coronary disease, heart failure, etc.). Advances in dealing with congenital heart diseases have allowed for an improvement in the survival rate and quality of life of these patients. This has meant the functional development of this demographic has become similar to that of the general population. From this, new issues arise, such as follow-up and recommendations regarding physical and sporting activity. Despite literature regarding sporting activity recommendations being limited, and with few studies performed on reduced groups of patients with short-term follow-up, the results are consistent in revealing that the benefits of exercise are applicable to people with congenital heart diseases.

At the start of the paediatric cardiology development, physical activity is, for the vast part of these patients, limited to performing recreational-type sporting activity. Follow-up of operated patients that also present a positive evolution has opened up new expectations regarding recommended activity. To this, we must add the fact that heart rehabilitation has acquired a very important role over recent years, and many studies have begun to include patients with congenital heart diseases to establish the benefits of physical exercise on this demographic.

It is important to highlight that the nature and intensity of physical training should be adapted to each individual in accordance with the type of congenital heart disease and the surgical correction, taking into account the clinical profile of each patient, including residual haemodynamic injuries, ventricular function, associated arrhythmias, etc. Additional research is required to identify the optimum exercise regimes for achieving the desired results in patients with congenital heart disease, and to establish strategies to effectively promote exercise-training recommendations as an integral component within a healthy lifestyle.

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Vichy Catalán y el colesterol

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El agua es un nutriente esencial para el hombre siendo su consumo indispensable para el mantenimiento del estado de hidratación del organismo y garantizar un buen estado de salud.

A nivel de composición nutricional, el agua aporta como únicos nutrientes los elementos minerales, presentes de forma natural en la misma. El tipo de minerales y el contenido de cada uno de ellos resultan característicos de las distintas aguas y por ello pueden caracterizarse. Vichy Catalán es un agua mineral natural carbónica que contiene 1.097 miligramos de sodio por litro, en cuya composición destacan además otros oligominerales como: bicarbonatos, sulfatos, cloruros y potasio. La biodisponibilidad de los electrolitos en esta agua es muy alta y por ello se considera que por un lado contribuye a la ingesta total diaria de estos nutrientes (FNB, 2004) y por otro que puede desempeñar un papel en la prevención de las enfermedades cardiovasculares.

En esta línea de evidencia, recientes investigaciones han demostrado que el consumo de 1 litro al día de agua mineral bicarbonatada como Vichy Catalán durante 8 semanas reduce el riesgo cardiovascular en mujeres postmenopáusicas y en adultos jóvenes hipercolesterolémicos, reduciendo tanto las cifras de colesterol-LDL como el ratio de colesterol total/colesterol HDL. A nivel de cifras tensionales, aún siendo el contenido en sodio del agua administrada superior a 1 gramo por litro, no se observa afectación en las cifras tensionales entre las mujeres postmenopáusicas e incluso se reducen las cifras de tensión arterial sistólica entre los adultos jóvenes (Schoppen S, 2004 y Perez-Granados, 2010).

Por otro lado, también se ha establecido la relación entre el consumo de 0,5 L/día de agua Vichy Catalán (agua mineral bicarbonatada) con una comida estándar y la reducción de la lipemia postpandrial en mujeres postmenopáusicas también sanas, respecto el consumo de agua mineral con menor contenido en minerales (Schoppen, 2005). Hallazgo de gran interés, ya que se sabe que el metabolismo lipídico postprandial juega un papel muy importante en la salud, ya puede ser un factor de riesgo en el desarrollo de aterogénesis y de las enfermedades cardiovasculares.

Ambos resultados obtenidos en estos estudios demuestran por tanto la influencia que los hábitos alimentarios y, en concreto, la hidratación y el tipo de agua de bebida, pueden tener en la prevención de las enfermedades cardiovasculares.

El efecto preventivo demostrado en estos estudios que ejerce el consumo de *Vichy Catalán,* tanto en el metabolismo del colesterol como en el de las lipoproteínas, parece ser debido a la composición característica de esta agua carbónica que la diferencia del resto de aguas comerciales, por su alto contenido en sodio, potasio, bicarbonato, sílice e incluso litio.

Además de los efectos preventivos a nivel cardiovascular anteriormente descritos, otras investigaciones recientes como la realizada por Toxqui (2012) estudian otros posibles efectos del consumo de agua bicarbonatada y la salud cardiovascular. En este caso, se estudian los efectos postpandriales de la ingesta de agua bicarbonatada sódica consumida con una comida estándar sobre los niveles séricos de triglicéridos (TG), de colecistoquinina y a nivel de la contracción y el vaciado de la vesícula biliar. Así se demuestra que en adultos jóvenes de 18 a 40 años de ambos sexos el consumo de 0,5 L/día de agua bicarbonatada sódica junto con una comida estándar (rica en grasas: 62% de lípidos, 30% de hidratos de carbono y 8% de proteínas) induce a menores niveles de triglicéridos y colecistoquinina postpandriales, elementos con claro impacto sobre la salud cardiovascular.

Los niveles de triglicéridos postpandriales son un reflejo del metabolismo lipídico postpandrial que tiene un papel fundamental en el desarrollo de las enfermedades cardiovasculares, ya que un anormal transporte y metabolismo de las lipoproteínas LDL (ricas en TG) en el periodo postpandrial se ha relacionado con la aterogénesis. Y, por lo tanto, como se demuestra en este estudio, una reducción en las lipoproteínas ricas en TG podría limitar la progresión de la arteriosclerosis.

La colecistoquinina por su parte es una hormona que estimula la contracción de la vesícula biliar que segrega las sales biliares encargadas de la solubilización y absorción de las grasas. Por tanto, una reducción en los niveles de colecistoquinina postpandriales supone a su vez la reducción de la contracción y vaciamiento de la vesícula biliar y en consecuencia una menor absorción intestinal de lípidos.

Por lo tanto, y a modo de conclusión, demostrado el efecto positivo que el consumo de agua bicarbonatada carbónica tiene sobre la salud, Vichy Catalán podría ser utilizado como un elemento a incluir en la alimentación habitual de la población sana para conseguir reducir el riesgo cardiovascular.

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- Una vez que se le confirme que su comunicación científica ha sido aceptada para ser presentada en forma de póster (presentación interactiva) debe enviar el documento electrónico **(.Ppt)**:
  - Trabajos destinados por el autor directamente a póster (presentación interactiva): **antes del 10 de septiembre de 2016.**
  - Trabajos destinados por el autor a Comunicación Oral y que el Comité Científico destina a póster (presentación interactiva): antes del 20 de septiembre de 2016.
  - El documento electrónico **(.Ppt)**: debe enviarse a la dirección electrónica del Congreso: congresos@femede.es.

Certificaciones

Tras la presentación de la comunicación oral o la defensa del póster en el modo en que se indique se entregará un único certificado al responsable de la comunicación científica.

Publicación de los trabajos científicos

Los abstracts de los trabajos científicos (comunicaciones orales y póster) aceptados y presentados en el XVI Congreso Nacional de la Sociedad Española de Medicina del Deporte serán publicados en la revista Archivos de Medicina del Deporte, publicación científica de esta especialidad y revista oficial de la Sociedad Española de Medicina del Deporte, que tiene una periodicidad de publicación bi-mensual.

ÍNDICE PREVIO DEL PROGRAMA CIENTÍFICO

SESIONES PLENARIAS

- Lesiones de partes blandas
- Reconocimientos: controversia EEUU-Europa
- Actualización sobre fisiología del ejercicio en entrenamiento y prescripción de ejercicio

PONENCIAS

- Traumatología - SETRADE
- Salud y ejercicio
- Actualizaciones en entrenamiento
- Fisiología aplicada al ejercicio físico y el deporte.
- Rehabilitación en patología deportiva

CONTROVERSIAS

- Electroestimulación corporal total
- Entrenamiento en altitud

PREMIOS

Los inscritos en el Congreso que presenten comunicaciones podrán optar al Premio a la **Mejor Comunicación oral** del Congreso.

Para optar al premio **SE DEBE HACER CONSTAR EXPLÍCITAMENTE QUE SE OPTA A PREMIO** en carta dirigida al Presidente del Comité Científico y adjuntar al Resumen remitido. En este caso, además de enviar el Formato del Resumen de Comunicación Científica, se debe de mandar el trabajo completo en el plazo de presentación de las Comunicaciones Científicas.

Los trabajos que se presentan en formato de póster (presentación interactiva) no optan a premio.

El trabajo que obtenga la segunda mejor puntuación, y supere en nivel de calidad exigible, será dotado con un accésit a la Mejor Comunicación del Congreso.

Dotación de los premios

Premio a la Mejor Comunicación oral del Congreso:

- Dotación económica: 1.500 euros.
- Certificado acreditativo.
- Publicación en la revista Archivos de Medicina del Deporte con indicación del premio obtenido.

Accésit a la Mejor Comunicación oral del Congreso:

- Dotación económica: 1.000 euros.
- Certificado acreditativo.
- Publicación en la revista Archivos de Medicina del Deporte con indicación del premio obtenido.

El premio será entregado en la cena de clausura del Congreso.

Los trabajos premiados serán publicados en la revista Archivos de Medicina del Deporte (para lo que deberán ser adaptados a las normas de publicación) y se aceptará la revisión efectuada por el Comité Científico).

Los premios podrán ser declarados desiertos si no alcanzan el nivel de calidad exigible.

XVI Congreso Nacional de la Sociedad Española de Medicina del Deporte

INFORMACIÓN GENERAL

Fecha	**23 al 26 de noviembre de 2016**
Lugar	**Hotel M.A. Nazaries** C. Maestro Montero 12. 18004 - Granada Teléfono: +34 958 18 76 00 Página web: http://www.hotelnazariesgranada.com
Secretaría Científica	**Sociedad Española de Medicina del Deporte** Apartado de correos 1207. 31080 Pamplona. Teléfono: +34 948 26 77 06. Fax:+34 948 17 14 31 Correo electrónico: congresos@femede.es Página web: http//:www.femede.es/congresodegranada2016
Secretaría Técnica	**Viajes El Corte Inglés S.A.** IATA 78211733. División Eventos Deportivos Teniente Borges, nº 5. 41002 Sevilla Teléfono: +34 954 50 66 20 Fax: +34 954 22 42 45 Correo electrónico: sevilladeportes@viajeseci.es
Idioma oficial	El lenguaje oficial del Congreso es el español. Traducción simultánea de sesiones plenarias y ponencias.

DERECHOS DE INSCRIPCIÓN

	Antes del 31-7-2016	Del 1-8-2016 al 10-11-2016	Del 11-11-2016 y en la sede del Congreso
Cuota general	400 euros	450 euros	500 euros
Miembros SEMED-FEMEDE	350 euros	400 euros	450 euros
Médicos MIR*	350 euros	400 euros	450 euros
Acompañantes	200 euros	300 euros	

*Es necesaria acreditación. Sin certificación se cobrará la cuota general.
Cuota general, SEMED-FEMEDE, MIR. Incluye la asistencia a todas las sesiones científicas, la documentación del congresista, los cafés, las comidas de trabajo y la exposición comercial.

FECHAS IMPORTANTES

Fecha límite de envío de la Comunicación Científica: **10 de septiembre de 2016.**
Notificación límite al autor: **15 días después de la fecha límite de envío.**
Fecha límite de pago de la inscripción del autor: **20 de octubre de 2016.**
Fechas del Congreso: **23-36 de noviembre de 2016.**

GUÍA PARA DEPORTISTAS DE RESISTENCIA A PARTIR DE LOS 50

Por: Joe Friel
Colección: En Forma
Edita: Ediciones Tutor S.A.
Marqués de Urquijo 34, 2º Izda. 28008 Madrid. Tel: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2015. 352 páginas. P.V.P: 25,00 euros

Hacerse mayor no tiene por qué significar volverse más lento. Con un enfoque correcto del entrenamiento, la edad no es más que un número, Basándose en las investigaciones más actuales sobre el envejecimiento y el rendimiento deportivo, el autor demuestra cómo los atletas que superan los 50 años de edad pueden competir con excelentes resultados y mantenerse con buena salud. Mediante el entrenamiento adecuado para protegerse de los efectos del envejecimiento, los deportistas pueden prolongar su carrera deportiva durante décadas; y competir para ganar.

La obra, indicada para cualquier deportista que desee mantener su ritmo deportivo durante más años: ciclistas, corredores, nadadores, esquiadores, triatletas…, ofrece una serie de normas acreditadas de programas de entrenamiento de alta intensidad, centradas en el trabajo de la fuerza, la recuperación, el entrenamiento cruzado y la nutrición para conseguir un alto rendimiento.

CROSSFIT® PROGRAMA AVANZADO. Entrenamiento intensivo de la fuerza y la resistencia

Por: Mario Petrik y Nicole Kaiser
Colección: En Forma
Edita: Ediciones Tutor S.A.
Marqués de Urquijo 34, 2º Izda. 28008 Madrid. Tel: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2015. 128 páginas. P.V.P: 19,95 euros

El CrossFit® es un sistema de entrenamiento para conseguir un rápido incremento de la fuerza y la resistencia con y sin aparatos. En el entrenamiento siempre hay que aspirar a llegar a los límites personales de rendimiento y proponerse superar nuevos retos. Este libro presenta nuevos ejercicios pensados especialmente para practicantes de nivel intermedio-avanzado de CrossFit®. Se entrena con el propio peso corporal, con *kettlebells,* con peso libre, con *Slam Balls* y con anillas de gimnasia. El plan de entrenamiento incluido ofrece instrucciones para la organización de los *Workouts* (WODS, entrenamientos del día) individuales.

En sus páginas se presenta todo lo referente a: Movilidad: Nuevos aparatos para el entrenamiento de nivel intermedio-avanzado; *Bodyweight Exercices:* Ejercicios con peso libre, con *kettlebells,* con anillas y con *Slam Balls;* Entrenamiento CrossFit®: Fundamentos, planificación, estructura del entrenamiento; Plan de entrenamiento para 8 semanas: Calentamiento, secciones de aprendizaje y de fuerza, *workout of the day* (WOD); y Alimentación y CrossFit®: Dieta de la zona (Dieta Sears) y Paleodieta.

PILATES PARA LA RECUPERACIÓN DEL CÁNCER DE MAMA

Por: Naomi Aaronson y Ann Marie Turo
Edita: Ediciones Tutor S.A.
Marqués de Urquijo 34, 2º Izda. 28008 Madrid. Tel: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2016. 240 páginas. P.V.P: 19,95 euros

Independientemente de si se está en tratamiento, de los efectos secundarios que se puedan experimentar o del nivel de forma física general, Pilates es una manera segura y efectiva de ayudar a recuperar flexibilidad, potencia y resistencia a la vez que de aliviar de los efectos adversos del tratamiento como, por ejemplo: edema linfático, fatiga, depresión, neuropatía periférica, osteoporosis o discapacidades en los miembros superiores. Las autoras, terapeutas ocupacionales e instructoras de Pilates, muestran cómo usar suaves ejercicios para fortalecer los brazos y los hombros, y recuperar el rango de movimiento; reducir el dolor y la hinchazón, así como estirar zonas tensas afectadas por cicatrices; desarrollar la fuerza de la zona media y la estabilidad de la espalda, especialmente importante después de cirugía de reconstrucción mamaria mediante colgajo miocutáneo transverso de recto abdominal (TRAM) o de la arteria perforante epigástrica inferior profunda (DIEP); mejorar el equilibrio y la coordinación; facilitar la realización de tareas básicas cotidianas; y aliviar el estrés y aumentar la energía.

En la obra e incluyen programas que pueden hacerse tumbada, sentada o de pie. Se busca ayudar a lograr el máximo bienestar en el momento actual y durante todo el resto del periplo vital después del cáncer.

2016		
Science in Football	1 Mayo Midlands (Reino Unido)	web: http://www.scienceandfootball.com/about
XVII ESSKA Congress	4-7 Mayo Barcelona	web: www.esska-congress.org/
XV Congreso de la SEMAM (Sdad. Española de Medicina y Auxilio en Montaña)	5-8 Mayo Granada	www.semamweb.com/congresos-y-eventos/congres/
VII Congreso de la Sociedad Catalana de Medicina del Deporte	6-7 Mayo Barcelona	E-mail: scme@academia.cat web: http://www.scme.cat
European medical fitness congress 2016	6-8 Mayo Madrid	E-mail: nfo@medicalfitnesscongress.com
54 Congreso de la Sdad. Española de Rehabilitación y Medicina Física	11-14 Mayo Málaga	web: www.sermef.es
XXX Jornada de pruebas de esfuerzo, 40 años de la inauguración del INEFC	13 Mayo Barcelona	E-mail: pmartinescudero@med.ucm.es
XX Congreso Anual AEMEF	23-24 Mayo Palma de Mallorca	E-mail: comunicación@aemef.org web: www.aemef.org
Cubamotricidad 2016 - Pan American Congress Sport for All TAFISA	25-28 Mayo Varadero (Cuba)	E-mail: convencion@inder.cu
III Congreso Internacional de Psicología aplicada al fútbol (AIPAF)	26-28 Mayo Deusto-Bilbao	web: www.jornadasaipaf.com
Retos Diagnósticos en Cardiología Deportiva	27 Mayo Villarreal (Castellón)	web: http://jornadacardiologiadeportivaendavant.blogspot.com.es/
Congrès 2016 –XXX Journée nationale de l'ANMSR	27 Mayo París (Francia)	E-mail: brigitte.darmon@psl.aphp.fr
10th International Society of Physical and Rehabilitation Medicine World Congress	29 Mayo-2 Junio Kuala Lumpur (Malasia)	web: www.isprm.org
Congreso Mundial de Fútbol	1-3 Junio Shanghai (China)	web: http://www.worldsoccercongress.net/
1as Jornadas Nacionales SETRADE	2-3 Junio Córdoba	web: www.setrade.org/jornadascordoba2016
XII Congreso Internacional de Ciencias del Deporte y la Educación Física	2-4 Junio Pontevedra	web: www.sportis.es
2nd European Congress of Hockey Medicine	2-4 Junio Bratislava (Eslovaquia)	E-mail: congress@szlh.sk web: www.hockeycongress.com
International Congress of Exercise and Sport Sciences	2-5 Junio Netanya (Israel)	web: http://www.reg.co.il/wingate2016/welcome_en.ehtml
47º Congreso Nacional de Podología	9-11 Junio San Sebastian	web: www.aepode.org

XXVII Jornadas de la Asociación Española de Médicos de Baloncesto	23-25 Junio El Ferrol (La Coruña)	web: aemeb.es/ferrol2016/
Science in Cycling	29-30 Junio Caen (Francia)	web: http://science-cycling.org/
21st Annual Congress of the European College of Sport Science	6-9 Julio Viena (Austria)	web: www.ecss-congress.eu/2016/
XXVII Congreso de AMLAR 2016	16-19 Agosto San Pedro Sula (Honduras)	web: www.amlar2016.com/
28th Symposium of the International Council for Physical Activity and Fitness Research (ICPAFR)	24-27 Agosto Kaunas (Lituania)	web: www.lsu.lt/en/icpafr-2016
International Sports Science and Sports Medicine Conference (ISSSMC)	31 Agosto - 2 Septiembre Newcastle (Reino Unido)	web: www.isssmc.com
International Convention on Science, Education and Medicne in Sport	31 Agosto - 4 Sepiembre Santos (Brasil)	E-mail: icsspe@icsspe.org web: www.iccspe.org
XVII Congreso Internacional de Dietética	7-10 Septiembre Granada	web: www.icdgranada2016.com web: www.hockeycongress.com
V Congreso Intern. de preparación física- V Simposium Internacional de Medicina del Deporte	16-18 Septiembre Montevideo (Uruguay)	E-mail: info@congresodepunta.com web: http://www.congresodepunta.com/es/home
25 Reunión Anual de la ESMAC (Sociedad Europea de Análisis de Movimiento en Adultos y Niños)	26 Septiembre -1 Octubre Sevilla	web: www.esmac2016.com
XXVII Cuban International Congress of Orthopedics and Traumatology	26 Septiembre - 1 Octubre Varadero-Matanzas (Cuba)	web: http://promociondeeventos.sld.cu/ortopedia2016en/
53º edición del Congreso de la Sociedad Española de Cirugía Ortopédica y Traumatología (SECOT)	28-30 Septiembre La Coruña	web: www.secot.es
XXXIV Congreso Mundial de Medicina del Deporte	29 Septiembre - 2 Octubre Ljubljana (Eslovenia)	web: www.fims.org
39th International Symposium on Sports Sciences	6-8 Octubre Sao Paulo (Brasil)	web: www.simposiocelafiscs.org.br/en/
46th Annual Meeting WMTS 2016 - World Medical Tennis Society	8-14 Octubre Lima (Perú)	web: http://wmtslima.com/
IV Congreso de la Sociedad Hispano Americana de Medicina del Fútbol	10-16 Octubre Quito - Galápagos (Ecuador)	web: http://www.hispamefgalapagos2016.com/
28º Congreso Nacional de Medicina Física y Rehabilitación	13-16 Octubre Bucaramanga (Colombia)	web: http://acmfr.org/
XVI Congreso Mundial en Cineantropometría	31 Octubre - 2 Noviembre Mérida (México)	E-mail: isak.2016@correo.uady.mx web: www.worldconferenceisakuady2016.com.mx/
IV Congreso conjunto SEROD-AEA	9-12 Noviembre Bilbao	E-mail: e.torres@torrespardo.com web: www.torrespardo.com

Congreso Uruguayo de Ortopedia y Traumatología	10-12 Noviembre Montevideo (Uruguay)	web: http://www.sotu.org.uy
XVI Congreso Nacional de la Sdad. Española de Medicina del Deporte (SEMED-FEMEDE)	23-26 Noviembre Granada	E-mail: femede@femede.es web: www.femede.es
2017		
30th International ACHPER Conference	16-18 Enero Camberra (Australia)	web: www.achper.org.au/professionallearning/2017-achper-international-conference
2017 Sports Science Summit	24-27 Enero Londres (Reino Unido)	web: www.lifescienceevents.com
X Curso de Medicina y Traumatología del Deporte: "Medicina y traumatología aplicada al deportista veterano"	17-18 Febrero Toledo	E-mail: docjimenez58@gmail.com
IOC World Conference on Prevention of Injury & Illness in sport	16-18 Marzo Mónaco (Ppdo. Mónaco)	web: http://www.ioc-preventionconference.org/
12º Congreso Bienal SETRADE	18-19 Mayo Pontevedra	E-mail: secretaria@setrade.org web: www.setrade.org
Movement 2017	9-11 Junio Oxford (Reino Unido)	web: www.movementis.com
5th CSIT World Sports Games	11-18 Junio Riga (Letonia)	web: www.csit.tv/en/world-sports-games
22nd annual Congress of the European College of Sport Science	5-8 Julio Ruhr Bochum (Alemania)	E-mail: congress@ecss.de web: www.ecss-congress.eu/2017
XIV Congreso Mundial de Psicología del Deporte	10-14 Julio Sevilla	web: www.issp2017.com/
XXI Congreso Internacional de Nutrición	22-27 Octubre Buenos Aires (Argentina)	web: www.icn2017.com
10th EFSMA (European Federation of Sports Medicine Associations) Congress	16-18 Noviembre Cascais (Portugal)	Email: secretariat@efsma2017.org web: www.efsma2017.org
2018		
XXXV Congreso Mundial de Medicina del Deporte	Brasil	web: www.fims.org

Cursos *on-line* SEMED-FEMEDE

Curso "ENTRENAMIENTO, RENDIMIENTO, PREVENCIÓN Y PATOLOGÍA DEL CICLISMO"

Curso dirigido a los titulados de las diferentes profesiones sanitarias y a los titulados en ciencias de la actividad física y el deporte, destinado al conocimiento de las prestaciones y rendimiento del deportista, para que cumpla con sus expectativas competitivas y de prolongación de su práctica deportiva, y para que la práctica deportiva minimice las consecuencias que puede tener para su salud, tanto desde el punto de vista médico como lesional.

Curso "ELECTROCARDIOGRAFÍA PARA MEDICINA DEL DEPORTE"

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (ON-LINE 15/10/2015 A 15/10/2016) CON 4,81 CRÉDITOS

Curso dirigido a médicos destinado a proporcionar los conocimientos específicos para el estudio del sistema cardiocirculatorio desde el punto de vista del electrocardiograma (ECG).

Curso "FISIOLOGÍA Y VALORACIÓN FUNCIONAL EN EL CICLISMO"

Curso dirigido a los titulados de las diferentes profesiones sanitarias y a los titulados en ciencias de la actividad física y el deporte, destinado al conocimiento profundo de los aspectos fisiológicos y de valoración funcional del ciclismo.

Curso "AYUDAS ERGOGÉNICAS"

Curso abierto a todos los interesados en el tema que quieren conocer las ayudas ergogénicas y su utilización en el deporte.

Curso "CARDIOLOGÍA DEL DEPORTE"

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (VÁLIDA DEL 15/10/2015 AL 15/10/2016) CON 8,78 CRÉDITOS

Fecha límite de inscripción: 15/06/2016

Curso dirigido a médicos destinado a proporcionar los conocimientos específicos para el estudio del sistema cardiocirculatorio desde el punto de vista de la actividad física y deportiva, para diagnosticar los problemas cardiovasculares que pueden afectar al deportista, conocer la aptitud cardiológica para la práctica deportiva, realizar la prescripción de ejercicio y conocer y diagnosticar las enfermedades cardiovasculares susceptibles de provocar la muerte súbita del deportista y prevenir su aparición.

Curso "ALIMENTACIÓN, NUTRICIÓN E HIDRATACIÓN EN EL DEPORTE"

Curso dirigido a médicos destinado a facilitar al médico relacionado con la actividad física y el deporte la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para prescribir una adecuada alimentación del deportista.

Curso "ALIMENTACIÓN Y NUTRICIÓN EN EL DEPORTE"

Curso dirigido a los titulados de las diferentes profesiones sanitarias (existe un curso específico para médicos) y para los titulados en ciencias de la actividad física y el deporte, dirigido a facilitar a los profesionales relacionados con la actividad física y el deporte la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para conocer la adecuada alimentación del deportista.

Curso "ALIMENTACIÓN Y NUTRICIÓN EN EL DEPORTE" Para Diplomados y Graduados en Enfermería

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (NO PRESENCIAL 15/12/2015 A 15/12/2016) CON 10,18 CRÉDITOS

Curso dirigido a facilitar a los Diplomados y Graduados en Enfermería la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para conocer la adecuada alimentación del deportista.

Más información:
www.femede.es

SYNVISC HYLAN G-F 20 **2 ml** SYNVISC ONE HYLAN G-F 20 **6 ml**

DESCRIPCIÓN

El hilano G-F 20 se encuentra disponible en dos presentaciones:

- **Synvisc®** (presentación de 2 ml).
- **Synvisc-One®** (presentación de 6 ml).

El hilano G-F 20 es un fluido elastoviscoso, estéril y apirógeno, que contiene hilanos. Los hilanos son productos derivados del hialuronato (sal sódica de ácido hialurónico), constituidos por disacáridos repetidos de N-acetilglucosamina y glucuronato sódico. El hilano A tiene un peso molecular medio de aproximadamente 6.000.000 y el hilano B es un gel hidratado. El hilano G-F 20 contiene hilano A e hilano B (8,0 mg ± 2,0 mg por ml) en solución fisiológica tamponada de cloruro sódico (pH 7,2 ± 0,3).

CARACTERÍSTICAS

El hilano G-F 20 es biológicamente similar al hialuronato. El hialuronato es un componente del líquido sinovial responsable de su elastoviscosidad. Sin embargo, las propiedades mecánicas (elastoviscosas) del hilano G-F 20 son superiores a las del líquido sinovial y de las soluciones de hialuronato de concentración comparable. El hilano G-F 20 tiene una elasticidad (módulo de almacenamiento G´) a 2,5 Hz de 111 ± 13 Pascales (Pa) y una viscosidad (módulo de pérdida G˝) de 25 ± 2 Pa. Elasticidad y viscosidad del fluido sinovial de la rodilla de humanos de 18 a 27 años de edad medidas con un método comparable a 2,5 Hz son G´ = 117 ± 13 Pa y G˝ = 45 ± 8 Pa. La degradación de los hilanos en el organismo sigue la misma vía que el hialuronato y sus productos de degradación carecen de toxicidad.

INDICACIONES Y MODO DE EMPLEO

El hilano G-F 20:

- Sustituye temporalmente y suplementa el líquido sinovial.
- Es eficaz en cualquier estadio de la patología articular.
- Es particularmente eficaz en pacientes que utilizan activa y regularmente la articulación afectada.
- Su efecto terapéutico se debe a la viscosuplementación, un proceso mediante el cual se restaura el estado fisiológico y reológico de los tejidos de la articulación con osteoartritis.

La viscosuplementación que se consigue mediante el tratamiento con hilano G-F 20 disminuye el dolor y las molestias, permitiendo una mayor amplitud de movimiento de la articulación. Estudios *in vitro* han demostrado que el hilano G-F 20 protege las células cartilaginosas contra ciertas lesiones físicas y químicas.

Synvisc ha sido concebido exclusivamente para la aplicación intraarticular por un médico, para el tratamiento del dolor asociado a la osteoartritis de rodilla, cadera, tobillo y hombro.

Synvisc-One ha sido concebido exclusivamente para la aplicación intraarticular por un médico, para el tratamiento del dolor asociado a la osteoartritis de rodilla.

CONTRAINDICACIONES

- No deberá inyectarse hilano G-F 20 en la articulación cuando exista estasis venosa o linfática en el miembro respectivo.
- El hilano G-F 20 no deberá utilizarse en articulaciones infectadas o intensamente inflamadas ni en pacientes que sufran enfermedades o infecciones de la piel en el área de aplicación de la inyección.

ADVERTENCIAS

- No inyectar intravascularmente.
- No inyectar en forma extraarticular o dentro de los tejidos y la cápsula sinovial. Efectos adversos, generalmente en el área de la inyección, han ocurrido después de la inyección extraarticular de **Synvisc**.
- No debe utilizarse junto a desinfectantes que contengan sales amónicas cuaternarias para la preparación de la piel ya que el hialuronato puede precipitarse en su presencia.

PRECAUCIONES

- El hilano G-F 20 no debe utilizarse si se produce un gran exudado intraarticular antes de la inyección.
- Como en todo proceso de invasión de articulación, se recomienda al paciente evitar toda actividad física intensa después de la inyección intraarticular y continuar con las actividades habituales pasados algunos días.
- El hilano G-F 20 no ha sido probado en mujeres embarazadas ni en menores de 18 años.
- El hilano G-F 20 contiene pequeñas cantidades de proteína aviar, por lo que no se debe utilizar en pacientes con hipersensibilidad a dicha proteína.

EFECTOS ADVERSOS

- Efectos adversos que afectan al miembro inyectado: dolor transitorio, hinchazón y/o exudación en la articulación inyectada después de las inyecciones intraarticulares de hilano G-F 20. Tras la inyección intraarticular de **Synvisc** o **Synvisc-One** se han notificado casos de inflamación aguda, caracterizados por dolor, hinchazón, exudación y a veces calor y/o rigidez en la articulación. En el análisis del líquido sinovial se constata la existencia de líquido aséptico sin cristales. Esta reacción suele producirse en unos cuantos días como respuesta al tratamiento con fármacos antiinflamatorios no esteroideos (AINE), esteroides intraarticulares y/o artrocientesis. El beneficio clínico del tratamiento es evidente después de dichas reacciones.
- Los ensayos clínicos de **Synvisc/Synvisc-One** no han evidenciado ninguna infección intraarticular y son pocos los casos de los que se han informado durante el uso clínico de **Synvisc**.
- También se ha informado de reacciones de hipersensibilidad, incluidas reacción anafiláctica, reacción anafilactoide, choque anafiláctico y angioedema. La experiencia tras su comercialización ha identificado los siguientes efectos sistémicos que aparecen rara vez con la administración de **Synvisc**: erupción cutánea, urticaria, comezón, fiebre, náuseas, dolor de cabeza, mareos, escalofríos, calambres, parestesia, edema periférico, malestar, dificultades respiratorias, enrojecimiento y tumefacción faciales.
- En ensayos clínicos controlados con **Synvisc** no hubo diferencias estadísticamente significativas en el número de efectos adversos sistémicos entre el grupo de pacientes que recibió **Synvisc** y el que recibió tratamientos de control.
- En ensayos clínicos controlados con **Synvisc-One** se observó que el tipo de efectos adversos ocurridos y la frecuencia con que se detectaron eran similares en el grupo de pacientes que recibió **Synvisc-One** y el grupo tratado con placebo.

DOSIFICACIÓN Y ADMINISTRACIÓN

- No utilice el hilano G-F 20 si el envase está abierto o deteriorado.
- Utilice el contenido de la jeringa inmediatamente después de abrir el envase.
- Retire el líquido o exudado sinovial antes de inyectar hilano G-F 20.
- La inyección deberá realizarse a temperatura ambiente.
- Para extraer la jeringa del envase (o bandeja), sujétela por el cuerpo, sin tocar el émbolo.
- La administración debe realizarse en condiciones asépticas, teniendo especial cuidado al abrir el tapón de la punta de la jeringa.
- Gire el tapón gris antes de tirar del mismo para evitar pérdidas del producto.
- Utilice una aguja de tamaño adecuado:
- **Synvisc**, calibre 18 a 22.

Elija una aguja de longitud apropiada en función de la articulación que vaya a tratar.

- **Synvisc-One**, calibre 18 a 20.
- Para asegurar un sellado hermético y prevenir pérdidas durante la administración, asegure la aguja correctamente mientras sostiene con firmeza el adaptador Luer de la jeringa.
- No apriete excesivamente ni haga palanca al fijar la aguja o al extraer su protector, ya que podría romperse la punta de la jeringa.
- Inyecte únicamente en el espacio sinovial recurriendo, si es necesario, a orientación adecuada, como la fluoroscopia, especialmente en articulaciones tales como la cadera y el hombro.
- El contenido de la jeringa es para un solo uso. Las instrucciones de dosificación recomendadas indican que debe inyectarse el volumen completo de la jeringa (2 ml para **Synvisc** y 6 ml para **Synvisc-One**).
- No reutilice la jeringa ni la aguja. La reutilización de jeringas, agujas y/o cualquier producto de una jeringa usada puede comprometer la esterilidad del producto, causar su contaminación y/o perjudicar el tratamiento.
- Cuando utilice guía fluoroscópica, puede emplear un agente de contraste iónico o no iónico. No debe utilizarse más de 1 ml de agente de contraste por cada 2 ml de hilano G-F 20.
- No reesterilice el hilano G-F 20.

POSOLOGÍA Y DOSIS MÁXIMA RECOMENDADA

El régimen de dosis de hilano G-F 20 depende de la articulación que se esté tratando.

Osteoartritis de rodilla:

Synvisc

El régimen de tratamiento recomendado consiste en una serie de tres inyecciones de 2 ml en la rodilla, con una semana de separación entre ellas. Para obtener el máximo efecto, es esencial la administración de la serie completa, es decir, las tres inyecciones. La dosis máxima recomendada es de seis inyecciones en 6 meses y con un mínimo de 4 semanas entre regímenes de tratamiento.

Synvisc-One

El régimen de tratamiento recomendado es una inyección de 6 ml en la rodilla, que puede repetirse a los 6 meses si los síntomas del paciente lo exigen.

Osteoartritis de cadera / tobillo / hombro:

Synvisc

El régimen de tratamiento inicial recomendado es una sola inyección de 2 ml. Sin embargo, si tras esa inyección no se logra el alivio sintomático adecuado, se recomienda aplicar una segunda inyección de 2 ml. Los datos clínicos han demostrado que los pacientes se benefician de esta segunda inyección si se administra entre uno y tres meses después de la primera.

DURACIÓN DEL EFECTO

El tratamiento con hilano G-F 20 únicamente afecta a la articulación inyectada, no produce efectos sistémicos generales.

Synvisc

En general, se ha informado de que la duración del efecto en pacientes que responden al tratamiento es de hasta 26 semanas, si bien se han observado períodos más cortos y más largos. Sin embargo, los datos clínicos prospectivos de pacientes con osteoartritis de rodilla han demostrado que, tras aplicar una única serie de tres inyecciones de **Synvisc**, los beneficios del tratamiento se han prolongado hasta 52 semanas.

Synvisc-One

Los datos de algunos ensayos clínicos prospectivos en pacientes con osteoartritis de rodilla han mostrado una reducción del dolor hasta 52 semanas después de una única inyección de **Synvisc-One** además de mejoras relacionadas con la rigidez y la capacidad funcional.

Los datos clínicos de un ensayo controlado, aleatorizado, doble ciego en pacientes con osteoartritis de rodilla han mostrado una reducción estadística y clínicamente significativa del dolor en comparación con el placebo. Se trató a un total de 253 pacientes (124 recibieron **Synvisc-One** y 129 recibieron placebo). En el transcurso de 26 semanas, los pacientes que habían recibido **Synvisc-One** demostraron un cambio porcentual medio del dolor en relación con el valor inicial del 36%, mientras que los pacientes en el grupo que recibió placebo presentaron un cambio porcentual medio del dolor en relación con el valor inicial del 29%.

Otros datos clínicos prospectivos procedentes de dos estudios multicéntricos abiertos en pacientes con osteoartritis de rodilla han mostrado mejoras estadísticamente significativas en el alivio del dolor en comparación con el valor inicial hasta 52 semanas después de una única administración de **Synvisc-One**.

En el primer estudio, 394 pacientes que recibieron **Synvisc-One** demostraron un cambio estadísticamente significativo en la subpuntuación WOMAC A1 (dolor al caminar) (-28 ± 19,89 mm en una EVA de 100 mm) en relación con el valor inicial durante 26 semanas. Además, se observaron cambios estadísticamente significativos en relación con el valor inicial en las puntuaciones WOMAC A1, WOMAC A, B y C en los seis períodos de observación entre las semanas 1 y 52, lo cual demuestra mejoras en el dolor al caminar y en el dolor (WOMAC A1: -32,7 ± 19,95 mm; WOMAC A: -29,18 ± 19,155 mm), la rigidez (WOMAC B: -25,77 ± 22,047 mm) y la capacidad funcional (WOMAC C: -25,72 ±19,449 mm) durante 52 semanas.

En el segundo estudio, 571 pacientes que recibieron **Synvisc-One** demostraron una mejora estadísticamente significativa en el dolor durante 26 semanas, según la medición mediante un cuestionario verbal del dolor (Verbal Pain Questionnaire, VPQ). La evaluación media del dolor mejoró de 3,20 en el momento inicial a 2,24 en la visita de la semana 26 y un 64,6% de los pacientes obtuvo alivio del dolor. Los criterios de valoración secundarios mostraron una mejora estadísticamente significativa en las puntuaciones VPQ en todos los momentos de observación desde la semana 1 hasta la 52, con puntuaciones VPQ en descenso de 3,20 en el momento inicial a 2,26 en la visita de la semana 52. Un 61,5% de los pacientes obtuvo alivio del dolor.

CONTENIDO POR ml (hilano G-F 20)

1 ml de **Synvisc** contiene: hilano 8,0 mg; cloruro sódico 8,5 mg; fosfato disódico hidrogenado 0,16 mg; fosfato sódico dihidrogenado 0,04 mg; agua para inyección c.s.

PRESENTACIÓN

El contenido de cada jeringa es estéril y apirógeno. Conservar a una temperatura de entre 2°C y 30°C. No congelar.

Synvisc se presenta en jeringas de vidrio de 2,25 ml, que contienen 2 ml de hilano G-F 20.

Synvisc-One se suministra en una jeringa de vidrio de 10 ml con 6 ml de hilano G-F 20.

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12 meses

1 inyección

1 ÚNICA INYECCIÓN que ha demostrado
12 MESES DE ALIVIO significativo del dolor
en pacientes con osteoartritis de rodilla[1]

SYNVISC ONE® HYLAN G-F 20

SANOFI

[1]Prospecto Synvisc® | Synvisc-One®.

PROES007072 Febrero 2015