Adductor functionality and strength in high-level rink hockey players

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Summary

Objective: To evaluate adductor strength and groin function in high level rink hockey players and its relationship with groin pain in the previous season.
Material and method: A cross-sectional study was performed where hip/groin strength and function was assessed via 5 seconds Squeeze Test and Hip and Groin Ouctome Score in 11 high level rink hockey players.
Results: Overall prevalence for groin pain was 81.8% (54% of the participants suffered groin pain during the previous season), and 18.2% suffered time-loss groin pain. Mean strength in the 5SST was 254.68N (3.25Nm/Kg) and HAGOS questionnaire reached 90/100 points in the whole sample. Similar adductor strength values were observed between healthy athletes and previously injured who suffered time-loss groin pain (*P*=0.261-0.948; g: 0.04-0.85). Statistically significant differences were found for the following HAGOS subscales: Pain, function, sports and recreational activities, and quality of life between groups (*P*=0.005-0.042; g: 0.34-2.65; r: 0.3-0.61).
Conclusion: More than a half of the participants suffered groin pain, of which one third suffered time-loss groin pain. Function assessed via HAGOS seems to be the main proxy that discriminates between groups. Medical staff should implement this questionnaire to detect and avoid the progression of this injury.

Key words:
Groin pain. Squeeze test. Rink hockey. Adolescent. Level of evidence: IV.

Funcionalidad y fuerza de aductores en jugadores de hockey sobre patines de alto nivel

Resumen

Objetivo: Evaluar la fuerza de los músculos aductores y la funcionalidad en jugadores de hockey sobre patines de alto nivel y su relación con sufrir dolor inguinal (DI) en la temporada anterior.
Material y método: Se realizó un estudio transversal donde se registraron los valores de fuerza mediante el *Squeeze Test* de 5 segundos (5SST), y la funcionalidad de la cadera e ingle mediante el cuestionario *Hip and Groin Outcome Score* (HAGOS) en una población de 11 jugadores de hockey sobre patines de alto nivel.
Resultados: La prevalencia total de DI fue de 81,8% (en la anterior temporada el 54% sufrió DI), de los cuales un 18,2% llegó a detener la práctica deportiva. La fuerza media para el 5SST es de 254,68N (3,25Nm/kg) y la funcionalidad alcanzó los 90/100 puntos en el cuestionario HAGOS para toda la muestra. La fuerza muscular fue similar entre jugadores que habían sufrido DI con pérdida de tiempo durante la última temporada y jugadores sanos en (p =0,261-0,948; g: 0,04-0,85). Se encontraron diferencias significativas en las siguientes subescalas del cuestionario HAGOS: Dolor, actividades deportivas y recreacionales, y calidad de vida entre ambos grupos (p =0,005-0,042; g: 0,34-2,65; r: 0,3-0,61).
Conclusión: Más de la mitad de los jugadores sufrieron DI, de los cuales un tercio llegó a detener su actividad. La funcionalidad medida a través del HAGOS se erige como el principal indicador que mostró diferencias entre grupos. Los servicios médicos de jugadores jóvenes de hockey sobre patines deberían usar este cuestionario para poder detectar precozmente la aparición y evitar la progresión de esta lesión.

Palabras clave:
Dolor inguinal. *Squeeze test*. Hockey sobre patines. Adolescente. Nivel de evidencia: IV.

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Introduction

Groin pain (GP) is a common complaint in sports involving changes of direction and pace, such as soccer, rink or ice hockey. Moreover, the literature on this subject has increased substantially since the publication of the Doha consensus establishing a standard terminology for the classification of this pathology[1]. Given the complexity of this injury, there is a need to quantify those cases in which the injured athlete continues activity but with reduced performance (non-time-loss injury) as well as those cases in which the athlete is forced to completely stop physical activity (time-loss injury [TL])[2]. In a season, the prevalence of time-loss groin pain (TLGP) varies between 13.6% and 32.5% depending on the sport in question, with soccer being the sport with the highest number of cases[3]. An analysis of the complete spectrum shows higher rates, even reporting a cumulative prevalence of GP of 45% up to 59% in some cohorts[4,5]. However, if only the TLGP is reported then this underestimates the extent of the issue. This is because, out of all the cases of GP, those with a time loss account for just 10-34% ((cases with time loss/total cases) × 100)[5,6].

The physiological characteristics of rink hockey could facilitate the occurrence of GP in this population. Thus, a player can skate up to 5,568 metres (SD = 0.750) in a game, of which 739 (SD = 0.209) are made at high speed (>5 m*s). Furthermore, the player performs more than 300 changes of pace during the game (160 ± 27 accelerations and 143 ± 26 decelerations), requiring great muscle strength in the lower extremities in order to cope with the demands of the sport7. The practice of sport involves a risk of sustaining an injury, and this is also the case for hockey. Recently, a number of studies have focussed on the epidemiology of this sport. Thus, there is a reported general incidence of 3.23 to 9.7 injuries per 1,000 hours of exposure[8,9]. On the other hand, a high incidence of tendinopathies has been observed in this population, accounting for 11% of the total injuries affecting the adductor muscles[10]. Quintana-Cepedal et al. observed that 16% of time-loss injuries affected the hip/groin and that the incidence of GP injuries was 0.71/1,000 h[9] The hip/groin is the area presenting the most problems in this sport, just like other multi-directional sports[6,11]. The main risk factors are: having sustained a previous episode of GP; having less strength in the adductor muscles; not following a specific exercise protocol for these muscles; getting poor results in the HAGOS questionnaire; or being a male athlete[12–16].

However, to date, no risk factor has been studied in rink hockey players and, in general, little analysis has been made of GP in youth populations. Therefore, the key objective of this investigation was to determine the strength values at 5SST and functionality (measurements through the HAGOS questionnaire) in high-level youth rink hockey players.

Material and method

Design

This cross-sectional analytical study was conducted in December 2021 (end of the first round of the competition league) on the occasion of the Spanish Regional Championship of Under-16 male rink hockey teams (Langreo, Asturias). The study followed the principles of the Declaration of Helsinki and the STROBE criteria (Strengthening the Reporting of Observational Studies in Epidemiology)[17]. The study was recorded in clinicaltrials.gov (ID: NCT05273008) prior to the inclusion of the first participant and has the approval of the Ethics Investigation Committee of the Principality of Asturias (Code: 2021.543).

Participants

The participants were selected by convenience sampling. A total of 12 athletes from the regional teams were eligible to participate in the study, with 11 of these players agreeing to take part in the investigation, obtaining data from 91.66% of the sample. The inclusion criteria were as follows: to be selected to participate in the championship and to agree to take part in the investigation, having signed the appropriate consent form. The exclusion criteria were: to have sustained a CPT injury in the 3 months prior to the championship or not to have played in any team match over the last season. Table 1 shows the demographic details of the participating athletes.

Procedures

Prior to the start of the study, the participants and their legal guardians were informed about how the study would be conducted and were given an information sheet and asked to sign a consent form to agree to participate. All the data were collected on the same day. Firstly, the participants completed the HAGOS questionnaire, and then the strength measurements were made. The HAGOS questionnaire measures functionality through 6 subscales (symptoms, pain, daily activity, sport and recreational activities, participation in physical activities, and quality of life) which are scored from 0-100[18]. This questionnaire was completed online using a Google form (https://forms.gle/LDZkavy7it85UMPT7) which also contained questions on demographic characteristics (age, height, weight) and prior history of GP (GP since starting to practice the sport and in the last season) differentiating between non-time-loss (the athlete can still participate but with a lower performance) and TL (the athlete stops activity for at least a day as a result of the injury). The

Table 1 Demographic information on participants.

Variable	Result
Age (IQR)	15 (15-15)
Height, cm	175.63 (6.56)
Weight, kg	68.54 (9.76)
BMI	22.20 (2.76)
Position P, Player	9 (81.8%)

The results are reported as Mean ± Standard Deviation (SD), Median and Interquartile Range (IQR), as appropriate. Position P: Position on the rink, BMI: Body Mass Index.

Figure 1. 5-second squeeze test (5SST).

strength of the adductor muscles was obtained through a 5SST using a handheld dynamometer (ActivForce 2, ActivForce, San Diego, CA, USA)[19]. Prior to the first measurement, two submaximal repetitions were made in order to familiarise the athlete with the test. The 5SST was made with the patient in a supine position and, with the examiner placing their forearm just above the medial malleoli, the participant was asked to continually and isometrically press one leg against the other while exerting the maximum possible force (Figure 1). Athletes were given verbal encouragement during each repetition in order to ensure that they exerted their maximum possible force. After each measurement, we recorded the peak force value (N) and the pain reported in the groin area on a visual analogue scale (0-10)[20]. The dominant leg, defined as the athlete's preferred kicking leg, was measured first[21]. A record was also made of the length of the extremity (from the anterior superior iliac spine to the medial malleolus) in order to calculate the torque generated based on the following formula: T = Nm/Kg, where T is the torque, Nm is the force measured in Newtons and multiplied by the length of the extremity (in metres), and Kg is the athlete's weight[22].

Statistical analysis

The statistical analysis was performed with SPSS version 21 (IBM, Chicago, IL, USA), the significance level was set to $p < 0.05$. The Shapiro-Wilk test was used to check the normality of the quantitative variables. The values were reported as either mean and standard deviation (SD) or median and interquartile range, as appropriate. The Student-t test was used for the hypothesis testing, comparing the TLGP in the last season with adductor strength and functionality (HAGOS). The Mann-Whitney U-test was used in those cases in which the distribution of the dependent variable was not normal. The effect size (ES) was calculated using Hedges' g in order to determine the practical relevance of the results. The effect sizes were classified as: Small (g = 0.2), medium (g = 0.5) and large (g = 0.8)[23]. For the non-parametric subscales of the HAGOS questionnaire the r statistic was used ($r = Z/\sqrt{n}$) which takes the following values: Small ($r < 0.3$), medium ($r > 0.3$ and < 0.5) and large ($r > 0.5$).

Results

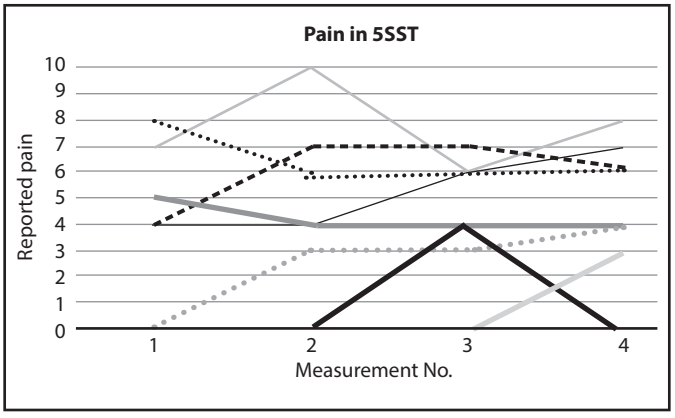
A total of 9 (81.8%) players had experienced GP throughout their respective sports careers and 6 (54%) during the past season. A total of 6 players had suffered TLGP while only 2 had to stop playing for this reason during the past season (18.2%). Figure 2 shows the pain scores reported by each player during the 5SST. For each 5SST, the mean pain reported was 3.1/10 (SD =3).

Groin pain and strength in the 5SST

For the entire population, the mean absolute strength for the dominant and non-dominant leg was 263.81 N (SD =43.5) and 245.54 N (SD =52.9), respectively. And 3.36 Nm/Kg (SD = (0.58) and 3.14 Nm/Kg (SD =0.79) reported in relative values.

Table 2 shows a comparison of the absolute and relative strength values for each group. No significant differences were found between healthy players and players with TLGP in the previous season for either absolute strength or relative strength (p =0.26-0.95).

Figure 2. Pain reported by the players in each 5SST.



Pain reported by the player on 0-10 VAS after each 5SST. Measurements 1 and 3 are for the dominant leg.

Table 2 Comparison between TLGP and healthy players for the strength variables.

	Healthy	GP CPT	Difference of means	ES (g)
Strength D, N	256.5 (43.7)	296.5 (32.5)	40	0.85
Strength ND, N	237.3 (55)	282.5 (19.7)	45	0.8
Torque D, Nm/Kg	3.36 (0.63)	3.33 (0.4)	0.03	0.04
Torque ND, Nm/Kg	3.12 (0.82)	3.24 (0.96)	0.12	0.13

N: Newtons, m: metres, Kg: Kilograms. The data are presented as a Mean (Standard Deviation). *p <0.05

Table 3 Comparison of the functionality measured with the HAGOS form, between healthy players and those who experienced TLGP last season.

Subscales	Healthy	GP CPT	ES
Symptoms	82.88 (12.4)	78.5 (4.9)	0.34[a]
Pain**	94.77 (3.9)	84 (1.4)	2.65[a]
ADL	100 (5)	90 (20)	0.31[b]
PISA	91 (19)	67 (28)	0.61[b]
PIPA	100 (25)	81.5 (13)	0.30[b]
QOL*	92.77 (6.6)	80 (7)	1.75[a]
Total*	92.1 (5.2)	80 (5.6)	2.10[a]

ADL: activities of daily living; PISA: participation in sports activities;
PIPA: participation in physical activity; QOL: quality of life; ES: effect size.
*p <0.05; **p <0.01; aHedges' g; br=Z/√n.

Groin pain and HAGOS

The average values for each subscale for the entire sample were 92.8 (SD = 5.61), 82.1 (SD = 11.4), 100 (Range = 20), 91 (Range = 47), 88 (Range = 25), 90.4 (SD = 8.2) and 90 (SD = 7) for symptoms, pain, daily activity, sport and recreational activities, participation in physical activity, and quality of life and the total (mean of the subscales), respectively. Significant differences were found for the subscales of pain, sport and recreational activities, quality of life and the total (p = 0.04-0.005) (Table 3).

Discussion

This is the first study to report values for strength, functionality and previous history of groin pain in youth rink hockey players. We found a prevalence of 54% groin pain, and one-third of the cases were associated with time loss in the last season. The strength values were similar in both groups. However, the values recorded in the subscales of pain, sport and recreational activities, quality of life and the mean of all the subscales were lower for injured players compared to healthy players.

The results show that practically half the players taking part in the study (54%) experienced GP during the last season. However, only 18.2% stopped their activity for at least one day due to this injury. The actual prevalence of this injury is underestimated when only the TLGP is reported. Mercurio *et al,* compared the prevalence of TLGP over a season in various sports, whereby soccer showed the greatest incidence (32.5%), followed by five-a-side soccer (25.5%) and basketball (25.2%). Given that sports disciplines such as water polo (17.6%) and volleyball (13.6%)[3] recorded similar values to our athletes, we could consider rink hockey to be a sport with a moderate risk of injury (18.2%) with regard to this pathology. Notwithstanding this, it should be clarified that our athletes are teenagers, unlike the aforementioned study in which the participants had an average age of 25 years. As hip/groin injuries account for 10-14% of total injuries in youth soccer players (under-16)[24,25], both sports share a similar prevalence. It is concerning to find these rates in athletes who are still physically developing, especially considering that the key risk factor for groin injury in the future is to have sustained such an injury in the past[12,13].

This pathology is complex and there is a need to study it in its entire spectrum. Our results reveal that 33% of GP cases are TL. Likewise, studies on soccer players report that 10-34% of GP cases are TL[5,6]. This same pattern can be seen in ice hockey where, over one season, the measurement of TLGP only accounts for 42.2% of all the cases. The evidence confirms the relevance of taking all episodes of GP into account, given that less than half are TL.

With regard to strength, this study is in line with others conducted on similar populations. We obtained an absolute and relative strength of 254.6 N and 3.25 Nm/kg, respectively. Two recent studies reported adductor strength values in soccer players from lower categories: for the under-17 category, the mean strength was 239.7 N; 3.1 Nm/kg and 289.9 N; 3.5 Nm/kg, in absolute and relative terms respectively[26,27]. Curiously, Esteve *et al*.[28] recorded the lowest strength values (2.81Nm/kg) in soccer players in the senior category (Age: 23 years, SD = 4), although this results could be explained by the fact that the measurements were taken during the pre-season. In view of our results, the practice of roller hockey leads to similar strength adaptations as to those found in soccer.

With regard to strength in the 5SST, no significant differences were found between the groups (p = 0.26-0.95). Although prior evidence affirms that a lack of strength is a risk factor for sustaining this injury[12,13], an analysis of the latest studies reveals contradictory results. Wörner *et al.*[22] reported a difference of 0.35Nm/kg (p <0.001) between the players exhibiting a pain of less than 3/10 during the 5SST, although in a later study, this same author found no differences (p ≥0.15)[29]. A possible explanation for the divergences described could be the lack of control over the length of time in which the players had been injured. If we take this factor into consideration, athletes experiencing GP for a duration of more than 6 weeks had 15.3% less strength than their healthy counterparts[28].

We recorded a total functionality of 90/100 measured through the HAGOS questionnaire. Healthy players scored 92.1/100 while players injured in the last season scored 80/100, giving a 12.1-point difference between the means. Furthermore, significant differences were found for 3 subscales (p = 0.05). Since it first started to be used, a number of studies have confirmed that the HAGOS tool is valid to differentiate between injured and healthy players. The first study published in 2013 obtained a total significant difference of 5.3 points, also finding differences in all the subscales[30]. More recent studies have reported total significant differences of between 8.2 to 20.6 points[31–33]. However, when comparing the results by subscales, only Carolan *et al*.[33] and Thorborg *et al.*[31] reported differences in all the subscales, while in the study by DeLang *et al.*[32] no differences were found in the subscales for activities of daily living, and sport and recreational activities. The differences between the studies may be due to the heterogeneous nature of the samples used in each one, despite the fact that they were conducted in different sports (soccer vs. hockey); our results are in keeping with those obtained by other groups of investigators[30–33].

This is the first study to report values for strength, functionality and history of GP in under-16 high-performance rink hockey players. However, it is not without limitations. Firstly, the study sample is small and

therefore has insufficient statistical power. A further limitation is that it did not record the length of time in which the players were experiencing GP. It is possible that some players may have had GP symptoms for a longer period of time. Despite this, the study does consider the entire spectrum of the injury and, therefore, there is no underestimation of cases. It is also made on a population for which little literature is available. In the future, other lines of investigation could focus on the epidemiology of the injury in female hockey, the functional shortcomings as a result of GP and which could condition performance, and prevention. For these subjects, studies are already available in other areas, with some promising results.

Conclusion

There is a high prevalence of groin pain in its entire spectrum in high-level youth players. Functionality, measured through the HAGOS questionnaire, was able to differentiate between healthy players and those with previous injuries, while strength was similar between groups. Within the detection and treatment of groin pain, HAGOS appears to be a good tool and, therefore, its use is recommended in this population.

Conflict of interest

The authors have no conflict of interest whatsoever.

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