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Evaluation of hand grip strength and range of movement of the upper limb in children with Polyarticular Hypermobility (PH).

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Summary

Introduction

Modern rehabilitation puts a great emphasis on early detection of faulty posture in children and adolescents. Unfortunately, proper recognition of joint hypermobility is neglected. Implementation of diagnostics and appropriate rehabilitation procedures in early stages of the disease will allow to prevent the occurrence of musculoskeletal diseases among those patients.

Aim

The aim of the study was to assess grip strength and mobility of the upper limb in children with polyarticular hypermobility.

Materials and Methods

The study was conducted on a group of children (n = 35), from 6 to 11 years old, who had been diagnosed with joint hypermobility using Beighton score criteria. The control group consisted of 35 healthy children of the same age. In all children measurement of grip strength was conducted using manual dynamometer and range of motion of the upper extremity joints was measured using a goniometer.

Conclusions

Conducted research showed that increased range of motion of joints of the upper extremity does not influence hand grip strength. Range of motion in both groups showed statistically significant differences.

Keywords: hypermobility, polyarticular hypermobility, hand grip strength, joint mobility of the upper extremity

Introduction

Joint hypermobility is an excessive mobility of the joint, which is characterised by range of motion above the standard without the presence of systemic symptoms. Two kinds of hypermobility can be distinguished: isolated and generalised (often referred as polyarticular hypermobility, PH) [1]. Hypermobility can be congenital or acquired - for example because of many years of training in fields like gymnastics or dance [2,3]. The occurrence of hypermobility can be affected by many factors, for example age, sex and race [4,5]. The occurrence of the hypermobility in the European population reaches 10%, in Asian and African populations it may reach up to 38% of people [6,7]. This condition is more prevalent in children than in adults. PH is 3 to 5 times more frequent in women - it is reported in up to 45% women and 30% men [8].

To diagnose PH a 9 - point Beighton score is applied. Because of its ease of implementation and high reproducibility, it is most frequently used by physicians and physical therapists [9].

It is worth highlighting that PH is frequent in general population and it may have an impact on biomechanical efficiency of joints. Therefore, special attention must be given to children who have PH diagnosed and continue training various sports. They suffer from frequent trauma, because distribution of forces in joints in PH patients is abnormal. That can lead to joint degeneration and lack of dexterity [10]. In children suffering from PH it is crucial to use closed kinetic chain exercises, which stabilise the joint, improve muscle strength and train proprioception, which is impaired in those patients [11-14].

In available literature both in polish and foreign language there is no data found that analyses hand grip strength and range of motion in the upper extremity in children suffering from PH, which prompted the authors to pick up this topic.

Aim

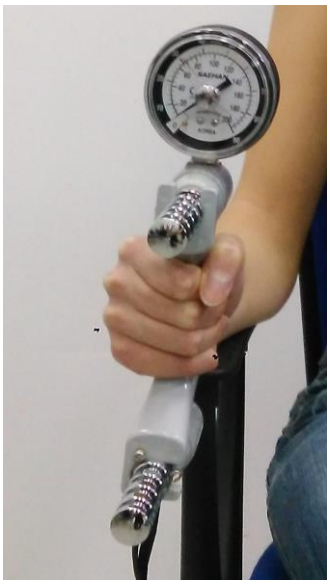
To assess hand grip strength and mobility of the upper extremity in children with polyarticular hypermobility.

Materials and methods

The study was conducted on a group of 102 children from the Primary School in Szczecin. Children's guardians were informed about the aim of the study and gave written consent to the participation of their children. In order to assess if PH is present a 9 - point Beighton score was used. It consists of: a passive extension of the V finger of the hand above 90°, ability to passive adduct the thumb to the inner surface of the forearm, elbow joint hyperextension above 10°, hyperextension of the knee joint of above 10° and a possibility to place palms on the ground with legs straight. PH was diagnosed if patient scored at least 4 points.

Hypermobility was found in 35 children (Group I), aged from 6 to 11 (14 girls and 21 boys). The control group (Group II) consisted of the same number of boys and girls in the same age as in test group, who didn't present joint hypermobility. In both groups hand grip strength was measured using Saehan Hydraulic Hand Dynamometer. Patient was asked to sit down, with arm adducted to the torso, elbow joint flexed to 90° and leaning on an armrest and wrist and forearm in neutral position (Photograph 1.). Each patient made 3 attempts with each upper limb. Children were told to "squeeze the handle as hard as possible". Intervals between attempts was 30 seconds, and attempts was made by rotation on each hand, to prevent muscle fatigue.

Pic. 1.



Pic. 2.

Pic. 1. Measurement of hand grip strength with Hand Dynamometer.

Pic. 2. SAEHAN Dynamometer.

The measurement of range of motion of the upper limb joints was then performed using Andrzej Zembaty's methods [15]: elevation through flexion, elevation through abduction, elbow extension, elbow flexion, dorsiflexion, palmar flexion, ulnar adduction, radial abduction. Ranges of motion were measured on both upper limbs with goniometer. All measurements were conducted in the gym (at 20° C) by the same person. Statistical analysis was done using Microsoft Excel 2013 and StatSoft 13.1. Student's t-distribution was used, and significance level was set at $p \leq 0.05$.

Results

Tab. 1. Characteristics of hand grip strength distribution

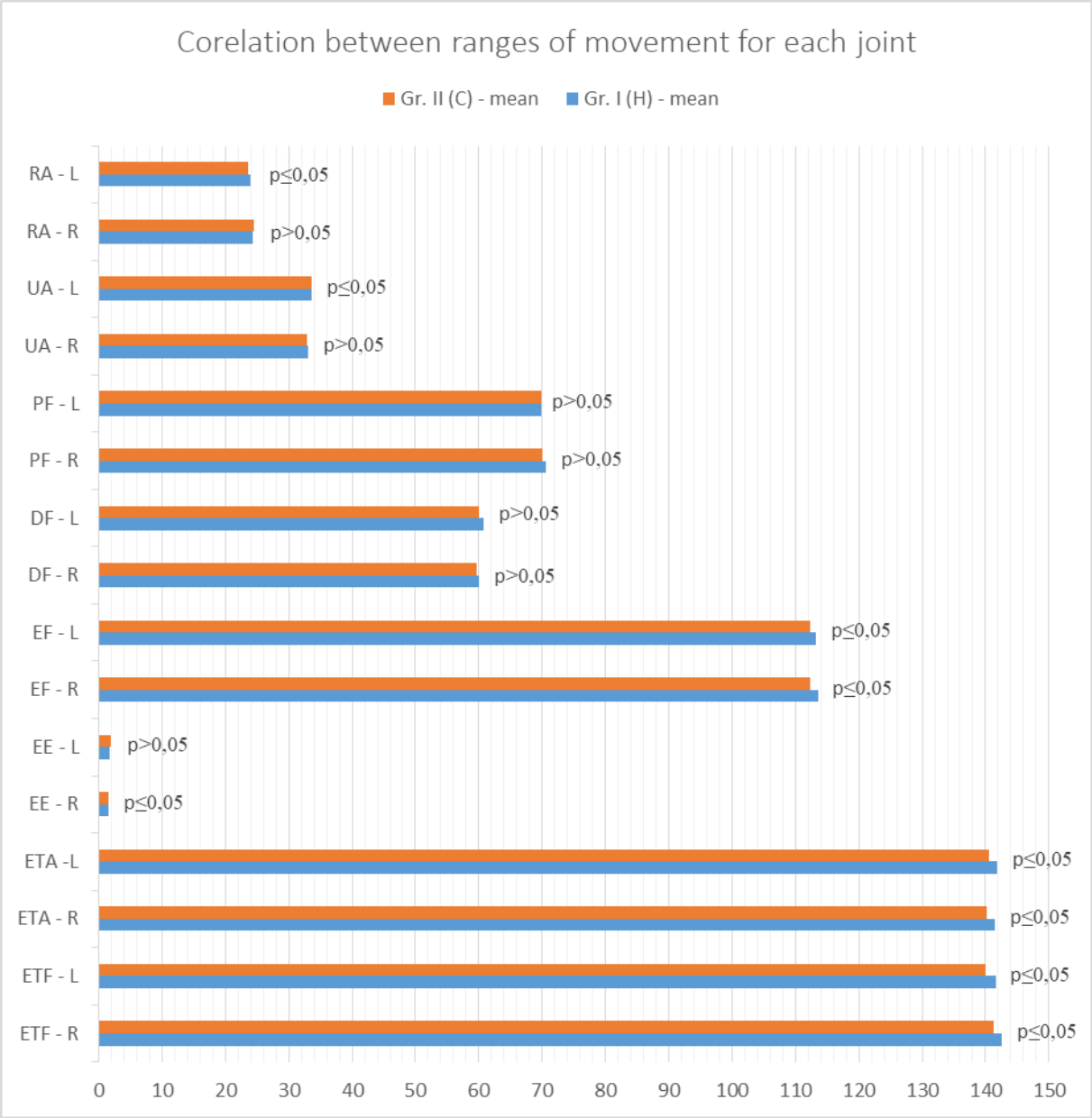
Characteristics of distribution	Hand grip strength [kg]			
	Left hand		Right hand	
	Group I (H) (n=35)	Group II (C) (n=35)	Group I (H) (n=35)	Group II (C) (n=35)
min - max	4.33 - 1.67	3.33 - 16.00	4.33 - 16.67	4.33 - 14.67
$\overline{x}$	10.15	9.49	9.67	9.24
m_e	11.00	9.67	9.33	9.33
SD	3.17	3.06	3.42	2.55
P (Student's t test)	0.37		0.55	
R	1.07		1.04	

Legend:

n – group size, Gr – group, H – hypermobile group, C – control group, min – minimal value, max – maximal value, $\overline{x}$ – arithmetic average, m_e – median, SD – standard deviation, p – statistical significance level, R – correlation.

Statistical evaluation of hand grip strength measurements between Group I and II shown no significant differences both for right hand (p=0.55) and left hand (p=0.37). The highest median noted was for left hand in group I (m_e=11.00), second was left hand in Group II (m_e=9.67). For the right hand in both groups median was equal (m_e=9.33) (Tab. 1.).

Graph below shows mean ranges of motion of all joints of the upper extremity for Group I and II. Next to each pair of columns, which refers to particular move statistical significance is stated.



Graph. 1. Correlation between ranges of movement for each joint.

Legend:

p – statistical significance, Gr – group, H- hypermobile group, C – control group, R – right side, L – left side, ETF – elevation through flexion, ETA – elevation through abduction, EE – elbow extension, EF – elbow flexion, DF – dorsiflexion, PF – palmar flexion, UA – ulnar adduction, RA – radial abduction.

As Graph 1 shows statistical analysis showed significant ($p \leq 0.05$) differences between Group I and II for elevation through flexion, elevation through abduction, elbow extension, right elbow flexion, left ulnar adduction and left radial abduction. Statistically significant differences were not found for dorsiflexion, palmar flexion, left elbow flexion, right ulnar adduction and right radial abduction (Graph 1).

Discussion

Underdiagnosing of the PH is a critical issue, currently often discussed in medical journals. Joint hypermobility may be a cause of injury during sports. Improperly dosed physical activity in PH patients is a reason of dysfunction of locomotor apparatus. Enrolment to fields of sports in which PH is perceived as an advantage must be done reasonably. This applies particularly to gymnastics, ballet, acrobatics and many others [16]. There is evidence to support the fact that PH is highly bound with frequency of sport injury in children [17]. The literature lacks the data which asses the influence of hypermobility on hand grip strength in children. Strength of other muscle groups may be treated as a similar parameter, but one needs to remember that it is only informational and cannot specify the impact of PH on hand grip strength. Pranay Jindal et al. assessed the influence of PH on muscle strength on a group of 53 “young adults”, including 25 men and 28 women, everyone approximately 20 years old. In this research it was proven that PH patients have significantly lower muscle strength, when measured in isometric conditions. No such correlation was found in women. As the researchers stated themselves, only the elbow and knee joints were assessed, what does not allow to draw a conclusion that muscle strength in general depends on range of motion and/or diagnosed PH [18]. On the other hand, Bente Rona Jensen et al. proven that girls suffering from PH have a better ability to quickly generate more force using muscle groups which move the knee joint - it was suggested that it may be compensatory mechanism, which allow the conservation of the proper function of the joint. Unfortunately, as the authors stated, despite proper function of the joint is conserved, the axial forces in the joint are greater, which may explain joint pain in these children [19]. Based on these studies it is impossible to determine the influence of range of motion on muscle strength, because cited papers do not present a consistent information; Although It is worth noting that both the age and sex of the patients, for whom statistically significant information was provided, was different in both papers, which makes comparison of the results impossible. The results of the latter cited paper are apparently backed by the data published by Tina Junge et al., which

proved that during jumping in PH patients the gastrocnemius muscle is overly activated. This probably happens to reduce the instability, which is caused by loosening of knee joint tendon system and lesser stabilising effect of the tendinous part of semitendinosus muscle. This research was conducted on 56 patients, where 26 shown hypermobility [20]. Enhanced muscle strength to compensate joint changes occurring in joint hypermobility seems to be biomechanically plausible hypothesis. Unfortunately, available research does not allow to objectively determine the relationship between PH and muscle strength, especially in children's population. Such analysis is more difficult concerning a fact, that published data seems to be partially incompatible. In order to confirm or exclude the hypothesis that in PH patients muscle strength is increased in order to compensate the joint changes, this research was conducted. In this paper an attempt to determine if PH is related to increased hand grip strength is made. No other papers which test this hypothesis were found. Some of the researchers believe that only the development of reference values of ranges of motion for specific joints, patient age, gender and race will allow reliable PH diagnosis. This implies that upper limit of normal should be well determined and available to use in clinical practice [21]. Physical activity is a natural need for children and it is a key factor in maintaining health and psychological comfort. When choosing a form of physical activity for children one must follow not only the child's interests and actual trends, but also a child's physical possibilities. Special attention must be paid to negative influence of some sports in PH patients. Faulty choice of type and quantity of activity, when PH is present, may lead to frequent injury and overloading of locomotor apparatus, which, in the future, may cause joint degeneration and disability [10].

Because of the consequences that PH may cause it is crucial to determine the risk factors, which can lead to improvement in diagnosing such patients, as well as implementing specific methods of prevention of injury [22]. Introducing PE teachers and sports coaches to this problem seems to be appropriate course.

Conclusions

1. Excessive mobility in the joints of the upper limb in children does not affect the hand grip.

2. Muscle strength in children with PH is comparable to children who does not present PH features.

3. Reference values of joint mobility in children should be determined.

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