CLINICAL SCIENCE

THE EFFECT OF WIDE SWADDLING ON ALPHA HIP ANGLE IN NEWBORNS AND INFANTS

Marina Komnenovikj[1], Zoran Bozinovski[2], Daniela Georgieva[2], Ilir Shabani[2], Milena Bogojevska-Doksevska[2], Dejan Damjanovikj[2], Igor Atanasovski[2]

[1] *Health Center, Skopje, Republic of North Macedonia*

[2] *University Clinic for Traumatology, Orthopedics, Anesthesia, Reanimation, Intensive Care and Emergency Center, Department for Orthopedic Diseases; Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*

Citation: Komnenovikj M, Bozinovski Z, Georgieva D, Shabani I, Bogojevska- Doksevska M, Damjanovikj D, Atanasovski I. The effect of wide swaddling on alpha hip angle in newborns and infants. Arch Pub Health 2025; 17 (1). 73-82.

doi.org/10.3889/aph.2025.6152

Key words: developmental hip dysplasia, sonography, Graf, prevention, wide swaddling

***Correspondence:** Marina Komnenovikj, Health Center, Skopje, Republic of North Macedonia.

Email: marinakomnenovik88@gmail.com

Received: 24-Feb-2025; **Revised:** 5-May-2025; **Accepted:** 12-May-2025; **Published:** 27-Jun-2025

Copyright:©2025. Marina Komnenovikj, Zoran Bozinovski, Daniela Georgieva, Ilir Shabani, Milena Bogojevska-Doksevska, Dejan Damjanovikj, Igor Atanasovski This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

Competing Interests: The author have declared that no competing interests

Abstract

Developmental dysplasia of the hip (DDH) is one of the most common diseases of the musculoskeletal system. Hip dysplasia occurs in 1:100, which means that it is 10 times more common than hip dislocation. The position of flexion and abduction in newborns and infants is the most common recommendation to improve hip development. The aim of this research is to evaluate the effects of wide swaddling, i.e., to determine whether wide swaddling influences hip maturation in the first months after birth and whether it has an effect on increasing the alpha angle of the hip during ultrasound examination. Materials and methods:

A prospective, clinical, stratified study was conducted on male and female newborns and infants with type Ia, Ib and IIa hip according to the Graf method. The subjects were divided into two groups. The first group included 20 newborns and infants using wide swaddling (40 hips monitored). The second group consisted of 23 newborns and infants who were not swaddled (46 hips monitored). The wide swaddling method involved using an additional cloth diaper and one wide swaddle diaper. Subjects underwent hip ultrasound according to the Graf method during the first hip examination at 4-8 weeks of age, and again two months after the initial assessment. Results: a simple procedure such as wide swaddling influences an increase in the alpha angle of the hip. There is an effect on hip development with faster transition from type IIa to type I according to the Graf method. After two months, the progression of hip maturation in the swaddling group was evident, while hips in the non-swaddling group remained type I and II, indicating that there is also a normal maturation in the other group. Further research is necessary to evaluate the long-term effects of wide swaddling on hip development.

КЛИНИЧКИ ИСТРАЖУВАЊА

ЕФЕКТОТ НА ШИРОКИОТ ПОВОЈ ВРЗ АЛФА АГОЛОТ КАЈ НОВОРОДЕНЧИЊА И ДОЕНЧИЊА

Марина Комненовиќ[1], Зоран Божиновски[2], Даниела Георгиева[2], Илир Шабани[2], Милена Богојевска-Доксевска[2], Дејан Дамјановиќ[2], Игор Атанасовски[2]

[1] *Здравствен дом, Скопје, Република Северна Македонија,*

[2] *Универзитетска клиника за трауматологија, ортопедија, анестезиологија, интензивна нега, Оддел за ортопедска хирургија; Медицински Факултет, Универзитет "Св. Кирил и Методиј" во Скопје, Република Северна Македонија*

Цитирање: Комненовиќ М, Божиновски З , Георгиева Д , Шабани И, Богојевска- Доксевска М, Дамјановиќ Д, Атанасовски И. Ефектот на широкиот повој врз алфа аголот кај новороденчиња и доенчиња. Арх Ј Здравје 2025;17 (1) 73-82.

doi.org/10.3889/aph.2025.6152

Клучни зборови: развојна дисплазија на колк, ехосонографија, Граф, превенција, широк повој

***Кореспонденција:**Марина Комненовиќ, Здравствен дом, Скопје, Северна Македонија.

E-mail: marinakomnenovik88@gmail.com

Примено: 24-фев-2025; **Ревидирано:** 5-мај-2025; **Прифатено:** 12-мај-2025; **Објавено:** 27-јун-2025

Печатарски права: ©2025. Марина Комненовиќ, Зоран Божиновски , Даниела Георгиева, Илир Шабани, Милена Богојевска-Доксевска, Дејан Дамјановиќ, Игор Атанасовски. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираа торигиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Развојната дисплазија на колкот (РДК) е едно од најчестите заболувања на мускуло-скелетниот систем. Дисплазијата на колкот се јавува на 1:100 што значи дека е 10 пати почеста од дислокацијата на колкот. Физиолошкиот развој на колкот за време на растот е детерминиран од централната поставеност на феморалната глава во ацетабулумот. Задржувањето на колковите кај новороденчињата во положба на флексија и абдукција е најчестата препорака за подобрување на развојот на колкот. Цел на ова истражување е да се утврдат ефектите од користењето на широкиот повој, односно да се одреди дали широкиот повој има ефект врз зголемување на алфа аголот на колкот кај новороденчињата и доенчињата во првите месеци од раѓањето и да се утврди дали влијае врз поврз развој на колкот. Материјали и методи: Спроведена е проспективна клиничка стратифицирана студија во која испитаници се машки и женски новороденчиња и доенчиња со тип Ia, Iб и IIa колк според методот Граф. Испитаниците беа поделени во две групи. Првата група од 20 новороденчиња и доенчиња користеше широко повивање (следени 40 колкови). Втората група од 23 новороденчиња и доенчиња не користеа широко повивање (следени 46 колкови). Широкиот повој се состоеше од дополнителна тетра и шведска пелена за широко повивање. Испитаниците се следеа ехосонографски по методата на Граф на првиот преглед кој се направи на возраст од 4-8 недели и вториот преглед по два месеци. Промените во алфа аголот на двете групи се следеа и се направи споредба. Резултатите покажуваат дека едноставен третман како користење широк повој има ефект врз зголемување на алфа аголот на колкот. Широкиот повој има ефект врз развојот на колкот да премине од тип IIa кон тип I по методот на Граф. По два месеци може да се види прогресија во созревањето на колковите во групата која користи широк повој, но и колковите од групата која не користи широк повој сè уште се тип I и II според методот на Граф што значи дека има нормално созревање на колкот и во таа група. Потребно е дополнително проучување и следење на долгорочните ефекти од користењето на широкиот повој.

Introduction

Developmental dysplasia of the hip (DDH) is one of the most common diseases of the musculoskeletal system. Hip dysplasia occurs at 1:100, which means that it is 10 times more common than hip dislocation. The femoral head and the acetabulum interact with each other in growth and evolution from the prenatal period onward. Physiological development of the hip during growth is determined by the central placement of the femoral head in the acetabulum.

Keeping the hips in flexion and abduction in newborns and infants is the most common recommendation to improve hip development.[1]

Swaddling in adduction and extension leads to tightness of the iliopsoas muscle, hamstrings, and abductor muscles, which leads to an increased hip dislocation. With 100 degrees of hip flexion, pressure in the acetabulum is reduced, and the dislocation force of the hamstrings is reduced.[2]

In African countries, where newborns and infants are held in a position of flexion and abduction, they do not develop hip dysplasia. This in contrast to some Asian countries, where, due to cultural differences, newborns are saddled with their legs in a position of extension and adduction, and this increases the risk of various degrees of hip dysplasia.[3-7]

In 1959, Judet and Gielis, for DDH prevention, placed all newborns in the position of flexion and abduction up to 4 months of age using an abduction orthosis. In the study by Klisic et al., the benefit of wide swaddling was especially confirmed by reducing the prevalence over the four years of the study period.[8,9]

In newborns, there is a certain degree of hip laxity after birth, and therefore swaddling in the abduction and extension position should not be used.4

It has been confirmed in a study of traditional Mongolian swaddling by Munkhtulga Ulziibat et al. that prolonged swaddling of infants with the legs in a position of extension and adduction leads to improper maturation and formation of the hip joint, and is a major contributing factor to developmental disorders of the hip.[5]

According to a study by Harcke et al. conducted on 30 newborns with suspected and documented DDH, it was shown that the subjects who used swaddling in the position of adduction and extension led to instability or hip dislocation, while in the subjects who used a safe swaddling position, i.e., a wide swaddle, there was no change in hip stability.[10]

The effectiveness of wide swaddling has never been verified.[1]

When dysplasia of the hip is diagnosed on an ultrasound examination, subsequent treatment is abduction and flexion of the hips with orthosis so that the femoral head is centered and acts as a stimulating factor for the acetabulum for its development. With hip flexion of 100 degrees, the pressure on the acetabulum is reduced and the dislocation force of the hamstrings is reduced.[11]

Attention must be paid to the so-called Ramsey's safe zone, which means that the abduction of the hip should not be greater than 70 degrees in order to avoid decreasing blood supply to the femoral head, which may increase the risk of avascular necrosis (AVN) of the hip.

Wide swaddling allows free movement of the lower limbs, while still improving the position of flexion and abduction, which is necessary for better development and maturation of the hip.

It is very important that it does not exceed abduction beyond 90 degrees, as this could impair femoral head circulation and increase the risk of AVN.[12]

In North Macedonia, general screening of hip development exists, and orthopedic examination and hip ultrasound are mandatory in the first 6–8 weeks. We are an endemic region for DDH, and recommendations for wide swaddling have been given, but its effectiveness is not proven.

Besides general screening, many newborns and infants were late for examination and hip ultrasound, and that's why they receive recommendations for wide swaddling in the newborn wards.

In the past, wide swaddling was more commonly practiced, but nowadays, many mothers are reluctant to use it.

One of the reasons is the lack of evidence for its effect on hip maturation, and doctor's recommendations differ from person to person.

The aim of this research is to verify the effects of wide swaddling, i.e., to determine whether wide swaddling influences hip maturation in the first months after birth, and whether the use of wide swaddling has an effect on increasing the alpha angle of the hip in ultrasound examination.

Materials and methods

A prospective clinical stratified study was conducted, in which subjects were newborns and infants with Type Ia, Ib, and IIa hips according to the Graf method. The subjects were divided into two groups. In the group that used wide swaddling, 20 subjects (5 male and 15 female) were monitored. In the group that did not use wide swaddling, 23 subjects (10 male and 13 female) were monitored. The progression of the alpha angle from the first to the second examination in both groups was assessed.

Types Ia and Ib hips were included to evaluate whether there would be greater progression of the alpha angle (exceeding 60 degrees) over time in the wide swaddling group compared to the non-swaddling group.

Type IIa represents a physiologically immature hip in infants younger than three months, characterized by an alpha angle below 59 degrees. Type IIa hips were included to assess whether wide swaddling would lead to faster hip maturation.

The two groups were compared to determine whether there was a statistically significant difference in alpha angle progression between the wide swaddling group and the non-swaddling group.

The wide swaddling consists of one extra cloth diaper and wide diaper for which parents have been instructed on how to use it properly. The Clinical history of all subjects was analyzed, including fetal position during regnancy, postural anomalies, birth weight, and vitamin D3 prophylaxis.

The swaddling group that met the inclusion criteria used wide swaddling for 24 hours. The wide swaddling was removed only to change the sanitary diaper and bathe the newborn and the infant.

The non-swaddling group used only a standard hygienic diaper.

Any subject older than 3 months of age that turns into IIb hip according to Graf's method is excluded from the research and treated according to the protocols.

Inclusion criteria were:

Newborns and infants with hip Type Ia, Ib and IIa according to Graf.

Singleton pregnancy, cephalic placement of the fetus, term newborns. New borns and infants younger than 3 months. Normal birth weight (2500- 4000 g) Negative family history of developmental hip dysplasia.

Negative clinical findings for hip instability, no adductor contractures, negative Ortolani and Palmén tests. Vitamin D3 prophylaxis on regular base.

Exclusion criteria were:

Newborns and infants that on hip sonographic examination are type IIb; IIc, IId, type III and IV hip according to Graf.

Twin pregnancy or pelvic positioning of the fetus, prematurely born. Newborns and infants older than 3 months. Low birth weight (under 2500 g). Positive family history of developmental hip dysplasia.

Positive clinical findings for hip instability, adductor contractures, positive tests for instability Ortolani and Palmén. Newborns and infants that don't have vit D3 prophylaxis on regular basis.

Clinical examinations were performed: assessment of hip position, presence of adductor contractures, and tests for hip instability including Ortolani and Palmén maneuvers.

Measurement of hip range of motion was performed using a goniometer. Ultrasound hip measurement, following Graf's method, was performed using a Sonoscape A6 ultrasound device equipped with a linear probe of 7.0–8.0 MHz. Hip sonographic examination following Graf's method was performed within the first 4–8 weeks after birth.

Newborns and infants were then monitored again after 2 months to assess whether the hips transitioned to Type Ia or Ib according to Graf's classification, or remained physiologically immature in both groups.

This follow-up also aimed to evaluate the progression of alpha angles in both hip types, particularly in Type I.

Three measurements form both hips were taken for each subject, and the mean value of the measured angles was taken, as well as measurement of the hip maturation time interval (from IIa to type I hip according to Graf's method).

According to Graf's method, the hip ultrasound examination is based on three points, and the classification is based on a combination of morphological and morphometric criteria as well as the age of the child. To acquire a correct measurement of the angles, we need to obtain three important morphological points: the bone part of the acetabulum, the iliac bone and the labrum.

Three basic lines are drawn: the basic bone line, the line of the bony part of the acetabulum and the line of inclination (the cartilaginous part of the roof of the acetabulum).

The alpha and beta angles are formed between these three lines, that togeth-

er with the age of the child are morphometric criteria for classification. Hips that have an alpha angle greater than 60 degrees are considered type I hip according to the Graf method, i.e. a mature hip. An infant with an alpha angle between 50 - 59 degrees and age under 3 months is considered type IIa hip according to the Graf method. Type IIa hips are considered physiologically immature hips and require follow-up and regular sonographic examinations until they spontaneously transition to a mature hip.[5, 13]

Results

Measurements of the alpha angle were conducted in 20 newborns and infants (40 hips) who used wide swaddling for a period of 2 months. The alpha angles from the first examination were compared with the angle from the second examination of 40 hips. Measurements were made in 23 newborns and infants (46 hips) who did not use a wide swaddle and alpha angles from the first examination were compared with the angle from the second examination of 46 hips.

The first and second exams of both hips in the wide saddling group and non-swaddling group are presented in pairs on their first and second exams of both hips. The average value of all hips was taken and are presented in pairs for both hips in both groups. (Table 1)

Table 1: Comparison of the alpha angle in subjects using wide swaddling on the first and second examination and comparison of the alpha angle in subjects not using wide swaddling on first and second examination

		Mean	N	Std. Deviation
Pair 1	With Swaddling –right first exam	63,80	20	3,10
	With Swaddling –right second exam	65,90	20	3,49
Pair 2	With Swaddling -left first exam	63,70	20	3,02
	With Swaddling -left second exam	65,80	20	2,52
Pair 3	Non-Swaddling-right first exam	66,08	23	3,02
	Non -Swaddling–right second exam	66,08	23	2,59
Pair 4	Non-Swadling-left first exam	65,65	23	2,40
	Non-Swaddling-left second exam	65,34	23	5,02

The average value of alpha angle in the group with wide swaddling for both hips on the first exam and after two months was compared. A progression in alpha angles for both hips of 2.1 degrees was registered. (Table 2)

Table 2: The average value from the first exam was compared with the second exam after two months of using wide swaddling.

	Average value		Average value
Alpha angle first exam right	63,8	Alpha angle first exam left	63.7
Alpha angle second exam right	65,9	Alpha angle second exam left	65
Difference in degrees	2,1	Difference in degrees	2,1
P value	0,0002	P value	0,006

The average value of alpha angle in non-swaddling group for both hips on the first exam and after two months was also compared. There was no progression in alpha angles. (Table 3)

Table 3: Comparison of the alpha angle in subjects in non-swaddling group

	Average value		Average value
Alpha angle first exam right	66,08	Alpha angle first exam left	65,65
Alpha angle second exam right	66,08	Alpha angle second exam left	65,34
Difference in degrees	0	Difference in degrees	0,31
P value	1,000	P value	0,770

Using paired sample test on right and left hips of wide swaddling group showed that there is significant difference between first and second exam after 8 weeks. (for swaddling group right hip t = 3,566, p < 0,05; left hip t =3, 070, p < 0,05).

The results showed that there is no significant difference in non-swaddling group between the first and second exam after 8 weeks. (for non-swaddling group right hip t = 0, 000, p>0,05|; left hip 0, 295, p>0,05).

Discussion

According to the study of Lee C.W. et al., double diapering resulted in a greater increase in the alpha angle, and more babies recovered to having bilateral Graf type I hips within 1 month compared to the natural maturation of newborn hips.

In this study, newborns with Graf type IIa hips were selected as subjects, as they are commonly observed to undergo maturation of the acetabular roof.[1]

A Graf type II hip is a physiologically immature hip that should be followed sonographically until transitioning to a type I hip. [9]

Swaddling into extension and adduction of the lower extremities increases the rate of hip instability.[5–7, 14]

Measurement of hip abduction and flexion angles is important because a certain degree of hip flexion and abduction has a stimulating effect on hip development.[3]

By placing the wide swaddle, greater hip flexion and abduction are achieved, which places the femoral head in a better position in the acetabulum and has a stimulating effect on its development. In the study by Rosendahl K., it was proven that patients who were treated with an abduction orthosis at the time of diagnosis of dysplasia had better and faster maturation of the hips than the group that was only monitored.[15]

Klisic, in his study “Effects on Triple Prevention for CDH,” shows that before the introduction of baby packages (which contain materials for wide diapering and are given to every new mother) in the period between 1975-1977, 202-208 new cases of DDH were registered each year (mean 221). After the introduction of baby packages, in the period between 1981-1985, there were only 69-90 new cases per year (mean 77), a reduction of 65%

was recorded.[8]

The results the study by Bing Liu et al. showed that during the first 3 months of life in newborns and infants, the alpha angle exhibits a monthly increase.[13]

The incidence of type IIa hips ranges from 5% - 12% according to the time of the ultrasound examination.

It has been reported that most cases with IIa hips spontaneously resolve when they get older. However, it is difficult to ascertain that all infants with Graf type IIa hips should be observed and evaluated for the natural course of type IIa hips using Graf perspective of physiological immaturity.[16]

Evidence that post-natal positioning may be responsible for DDH comes in the form of a higher incidence of DDH seen in populations which practice restrictive immobilization of the lower limbs of their infants (swaddling in adduction and extension).

Czeizel et al. reported that out of 18,219 live births in Bekes County, Hungary, between 1970 and 1972, 523 infants came for treatment of DDH. Apart from genetic factors, the authors attributed this unusually high incidence of 28.7 per 1000 live births to unhealthy restrictive swaddling practices then prevalent in the studied population.[14]

Ulziibat M et al. conducted a study with two groups, one that used traditional Mongolian swaddling (with legs in adduction and extension) and one no swaddling group.

The follow up lasted one month (it was not allowed to continue the swaddling more than 1 month for the study purpose because of the Ethical Review Committee's recommendations).

In both groups type I and II a+, II a- hips were included.

The study provides evidence that traditional swaddling is a significant contributing factor for delayed maturation of the physiologically immature Type 2a hips and development of DDH. [5]

In the previous studies, swaddling groups (in adduction and extension) were compared with non-swaddling groups.

There are few studies that compared safe- wide swaddling (with lower extremities in abduction and flexion) with no swaddling group.

In our study, newborns and infants with type I and type IIa hips according to Graf's method were selected. A comparison was made between 40 hips in the group that used wide swaddling and 46 hips in the group that did not, with a follow-up period of 2 months.

It was determined that in the group that used wide swaddling, there was a significant increase in the alpha angle of the hip during the first two months of use.

The increase in the alpha angle from the first to the second examination was about 2.1 degrees for both hips, while in the subjects who did not use wide swaddling, there was no significant increase in the alpha angle after two months from the first examination.

After the comparison of the group that used wide swaddling between the first and second examination, there is a statistically significant difference ($p < 0.05$) compared to the group that did not use wide swaddling where there was no statistically significant difference in the alpha angle between

the first and second examinations ($p > 0.05$).

After the comparison of the group that used wide swaddling compared to the group that does not use it, it was determined that there is a significant difference in the increase of the alpha angle of the hip in patients that used a wide swaddling.

Compared to the Study from Lee and al. we have similar progression of alpha angle in the swaddling group. From the first examination at birth, they have mean progression after 1 month of +7, 9 in double diapering group. In the non-swaddling group from birth after one month they have progression of + 5, 2 degrees.[1]

The study by Raba A.A. and colleagues discusses and has a special focus on type IIa hips, where it's not possible to determine which hips will deteriorate or have a spontaneous evolution and that this should be investigated further, but as an independent warning factor it emphasizes that if the alpha angle at the first examination is less than 55 degrees then that hip has a negative predictive factor. [16]

In the study by Riad P. J and colleagues, subjects aged 6 to 12 weeks were followed and the progressions of alpha and beta angles as well as FHC were monitored and measured.

It was concluded that FHC alpha and beta angles change significantly over time, but it is important to take the age of the child into account when interpreting hip ultrasound findings.[17]

We need more follow up of this, because we need to distinct if there is an effect from wide swaddling on hip maturation and progression of alpha angle.

Some studies conclude that the hip in the first months of life had exponential growth and maturation with plateau in the 4-6 months of life.[13]

In our country, among the pediatric orthopedic surgeons, there is an ongoing lively discussion whether double diapering should be used or not. Most of the older orthopedic surgeons adhere strictly to the double diapering principle that roots from the Klisic conclusions, and their use is justified. Most of the younger orthopedic surgeons that are involved in the neonatal hip ultrasound screening, do not recommend wide diapering in type 2a+ or 1a/1b hips according Graf method. The positive effect from double diapering is concluded in this and many previous studies. It is also recommended in most neonatal wards in our country.

There is no consensus among the ones recommending wide diapering, and the recommendations differ from two hygienic diapers placed one above the other, one or two cloth diapers above the hygienic diaper, secured by a wide swaddle diaper or commercially available "wide diapering underpants". Also, there is no consensus on the duration of the wide diapering, some of us discontinue the use of the double diapering at the first ultrasound screening examination, that should be done by three months of the infant, or the second ultrasound examination screening, that is done at 6 months of age. Also, there are some studies that conclude that the diapering delays infant's milestones as sitting, crawling and walking.[18]

Conclusion

The results show that a simple treatment, such as wide swaddling, contributes to an increase in the alpha angle of the hip. The results also show that there is an effect on the development of the hip to go from type IIa to type I according to Graf's method.

After two months we can see the progression of hip maturation within the swaddling group, but the hips within the non-swaddling group are still type I and II according to Graf method that means we also have a normal maturation in the other group.

Regarding this fact we need further studies and monitoring of the long-term effects of using wide swaddling to determine whether it has effect on hip maturation and progression of alpha angle or it is spontaneous maturation with rapid progress in some hips.

References

1. Lee WC, Kao HK, Chen MC, Yang WE, Chu SM, Chang CH. Double diapering facilitates hip maturation in newborns. Pediatr Neonatol. 2022; 63(2):159–64. doi: 10.1016/j.pedneo.2021.06.021.
2. Yamamuro T, Ishida K. Recent advances in the prevention, early diagnosis, and treatment of congenital dislocation of the hip in Japan. Clin Orthop Relat Res. 1984; (184):34–40. doi:10.1097/00003086-198404000-00005.
3. De Pellegrin M, Damia CM, Marcucci L, Moharamzadeh D. Double diapering ineffectiveness in avoiding adduction and extension in newborns hips. Children. 2021; 8(3). doi. 10.3390/children8030179.
4. Vaidya S, Aroojis A, Mehta R. Developmental Dysplasia of Hip and Postnatal Positioning: Role of Swaddling and Baby-Wearing. Vol. 55, Indian Journal of Orthopaedics. Springer; 2020. p. 1410–6. doi: 10.1007/s43465-021-00513-3.
5. Ulziibat M, Munkhuu B, Bataa AE, Schmid R, Baumann T, Essig S. Traditional Mongolian swaddling and developmental dysplasia of the hip: a randomized controlled trial. BMC Pediatr. 2021; 21(1). doi: 10.1186/s12887-021-02910-x.
6. Graham SM, Manara J, Chokotho L, Harrison WJ. Back-carrying infants to prevent developmental hip dysplasia and its sequelae: Is a new public health initiative needed? Vol. 35, Journal of Pediatric Orthopaedics. Lippincott Williams and Wilkins; 2015. p. 57–61. doi: 10.1097/BPO.0000000000000234.
7. Kotlarsky P, Haber R, Bialik V, Eidelman M. Developmental dysplasia of the hip: What has changed in the last 20 years? World J Orthop. 2015; 6(11):886–901. doi: 10.5312/wjo. v6. i11.886.
8. Klisić P, Zivanović V, Brdar R. Effects of triple prevention of CDH, stimulated by distribution of "baby packages". J Pediatr Orthop. 1988; 8(1):9–11. doi: 10.1097/01241398-198801000-00002.
9. Graf R. Classification of hip joint dysplasia by means of sonography. Arch Orthop Trauma Surg. 1984; 102(4):248–55. doi: 10.1007/BF00436138.
10. Harcke HT, Karatas AF, Cummings S, Bowen JR. Sonographic Assessment of Hip Swaddling Techniques in Infants with and Without DDH. J Pediatr Orthop. 2016; 36(3):232–8.

doi: 10.1097/BPO.0000000000000446.

11. Staheli LT. Management of congenital hip dysplasia. Pediatr Ann. 1989; 18(1):24, 26–7, 29–32. doi: 10.3928/0090-4481-19890101-06.

12. Liu YH, Xu HW, Li YQ, Hong K, Li JC, Pereira B, et al. Effect of abduction on avascular necrosis of the femoral epiphysis in patients with late-detected developmental dysplasia of the hip treated by closed reduction: A mri study of 59 hips. J Child Orthop. 2019; 13(5):438–44. doi: 10.1302/1863-2548.13.190045.

13. Liu B, Hu X, Li L, Gao S. Morphological development of the hip in normal infants under six months of age by the Graf ultrasound method. Front Pediatr. 2022; 10. doi: 10.3389/fped.2022.914545. 14. Czeizel A, Szentpetery J, Kellermann M. Incidence of congenital dislocation of the hip in Hungary. Brit J Prev Soc. Med. 1974; 8 doi: 10.1136/jech.28.4.265.

15. Rosendahl K, Markestad T, Lie RT. Ultrasound screening for developmental dysplasia of the hip in the neonate: the effect on treatment rate and prevalence of late cases. Pediatrics. 1994; 94(1):47–52.

16. Raba AA, Gasibat Q. Developmental Dysplasia of the Hip: Management of Graf IIa Dysplastic Hip. Open J Pediatr. 2020; 10(02):247–54. doi: 10.4236/ojped.2020.102025. 17. Riad JP, Cundy P, Gent RJ, Piotto L, Morris L, Hirte C. Longitudinal study of normal hip development by ultrasound. J Pediatr Orthop. 2005; 25(1):5–9. doi: 10.1097/00004694-200501000-00003.

18. Cole WG, Lingeman JM, Adolph KE. Go naked: diapers affect infant walking. Dev Sci. 2012; 15(6):783–90. doi: 10.1111/j.1467-7687.2012. 01169.x,