Is selective hip dislocation screening at the age of 4 months sufficient?

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Research Article

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Abstract

Background

This study aimed to investigate whether performing selective hip dislocation screening at the age of 4 months would result in refractory or overlooked cases.

Methods

The study included 526 hips of 263 infants were screened for hip dislocation at a primary health check-up, and then visited our department for secondary health check-ups for hip dislocation. Ultrasonography was performed at the initial visit and 3 months later. X-rays were performed at the age of 1 year, and the proportion of patients with an acetabular index of ≥30° were evaluated.

Results

The mean age at the initial visit was 4.6 months. The percentage of patients diagnosed with developmental dysplasia of the hip was 4.9%. There were no refractory cases. Moreover, none of the patients with Graf classification Type I at the initial visit worsened to ≥Grade II after 3 months. The acetabular index was ≥30° in 35 of the 402 hips (8.7%) at the age of 1 year.

Conclusion

Performing selective hip dislocation screening at the age of 4 months did not lead to any refractory cases or delayed diagnoses.

Introduction

Although ultrasonography screening for developmental dysplasia of the hip (DDH) is often performed for all newborns in Europe [1–8], such screening is limited to newborns with risk factors for DDH in some regions [9]. In Europe and North America, if there are risk factors for DDH, ultrasonography is routinely performed before the age of 6 months [10]. This is because DDH can be successfully treated with measures, such as harnesses, when diagnosed before the age of 6 months [11–13]. What is the optimal time for DDH screening? Screening is performed for all infants in some countries and regions; however, in other countries and regions only those with risk factors are screened. This is because the incidence of DDH, economic status, social infrastructure, and history of medical treatment vary among countries and regions.

Several reports indicated that follow-up is not necessary if screening for DDH is performed during the neonatal period and when ultrasonography results are normal [7–9, 14]. However some reports indicated that dislocations were later discovered in some patients despite initial ultrasonography assessment results in the neonatal period being normal [3–5].

Because there are no laws regarding screening for DDH in Japan, there is no standard rule for the method and timing of screening. Thus, screening is performed according to rules determined by local municipalities, and there are no set guidelines in Japan on how to conduct DDH screening.

In the “Guide to hip dislocation in infant health check-ups” published by the Japanese Society of Pediatric Orthopaedic Surgery, the following five factors are listed as risk factors: (1) limited abduction and flexion, (2) asymmetry of femoral or inguinal skin creases, (3) family history, (4) female infant, and (5) breech delivery. The guidelines recommended that those with either (1) present or meet two or more of criteria (2) to (5) be referred for a secondary examination for hip dislocation [15]. In Nagasaki City, an infant health check-up is performed by a pediatrician for all infants at the age of 4 months. In such cases, a primary check-up for hip dislocation is performed, and the patient is referred to an orthopedist for a secondary check-up for hip dislocation as per the aforementioned guide.

The present study aimed to perform a selective screening ultrasonography examination in infants with risk factors at the age of 4 months to determine whether they were difficult to treat or treatment was missed. If this method is deemed acceptable, the recommendation is to introduce the method in countries and regions where manpower is limited to testing all newborns.

Materials And Methods

We evaluated the number of births in Nagasaki City from April 2015 to March 2018, the number of infants who underwent a primary health check-up for hip dislocation, and the number of infants who were referred to a secondary health check-up for hip dislocation in Nagasaki City. Moreover, the proportion of patients referred to a secondary health check-up for hip dislocation was analyzed.

The number of infants who visited our department for a secondary examination of hip dislocation and their age at the initial visit were evaluated. Physical examination and ultrasonography were performed in all infants who visited our department. These procedures were performed by Shohei Matsubayashi who had >10 years of experience in pediatric orthopedics. The ultrasonography results were evaluated using the Graf classification [14]. Patients with Graf ≥Type II disease were diagnosed with DDH, and the proportion of infants who were diagnosed with DDH among those who underwent a secondary examination for hip dislocation at the age of 4 months was evaluated. In addition, reasons for referral and treatment methods as well as outcomes after DDH diagnosis were evaluated.

We analyzed the reason for referral to our department for a secondary examination that resulted from a primary examination for hip dislocation. Limited abduction and flexion was defined as an angle of ≥20° between the femur axis and the floor when viewed from the buttocks and when the hip joint is abducted with the infant lying in a supine position and the hip joint and knee joint flexed at 90°.

Graf classification at the initial visit (age, 4 months) was compared to that observed 3 months later (age, 7 months) in infants who were diagnosed with Graf classification Type I (normal) at the secondary

examination at the age of 4 months. In addition, X-ray was performed at the age of 1 year, and the presence or absence of dislocation and the proportion with an acetabular index of ≥30° were evaluated.

All procedures in this study were performed in accordance with the ethical standards of the Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (approval number: 20032322).

Results

A total of 9,517 infants were born in Nagasaki City between April 2015 and March 2018, and 9,251 patients underwent health check-up for hip dislocation. Among these, 488 patients (5.3%) were referred for follow-up examination for hip dislocation. Of the 488 patients, 263 patients were examined at our department, while the remaining patients visited other clinics (Table I).

The mean age at the initial visit was 4.6 months. Among the 263 infants referred to our department for a secondary hip dislocation screening, 250 were Graf classification Type I (normal), 9 were Type II (acetabular dysplasia), 2 were Type III (dislocation), and 2 were Type IV (high dislocation). A total of 13 patients were ≥Type II (Table II), and all were unilateral patients. Thus, 4.9% of the patients were diagnosed with DDH.

Reasons for the referral of infants with a diagnosis of DDH were limited abduction and flexion in 6/13, asymmetric femoral or inguinal skin creases in 6/13, family history in 1/13, and female infant in 8/13. No infants were born via breech delivery.

Nine patients who were diagnosed with Graf Type II (acetabular dysplasia) only underwent follow-up after DDH diagnosis, and all these patients became Type I (normal) after 3 months. Type III (dislocation) and Type IV (high dislocation) patients (n = 2 each) were treated using a Pavlik harness. All dislocations were reduced, and no patient developed complications, such as avascular necrosis of the femoral head. At present, additional procedures, such as pelvic osteotomy, may not be necessary.

Limitations of abduction and flexion were the most common reasons for referral to a health check-up for hip dislocation (Table III). Asymmetry of the femoral skin creases or inguinal skin creases and female infant were the other most common reasons (Table IV).

At the initial examination (age, 4 months), 250 infants were diagnosed with Graf classification Type I, and 233 infants were examined at our institution after 3 months with a follow-up rate of 93.2%. Three months later, none of the hips worsened from Type I to ≥Type II. Of the 233 infants, 201 infants who were diagnosed with Graf Type I at the initial visit (age, 4 months) were examined at the age of 1 year with a follow-up rate of 76.4%. None of the infants experienced dislocation. The mean acetabular index at the age of 1 year was 24.1° (male 22.7°; female 24.5°). The acetabular index was ≥30° in 35 of the 402 hips (8.7%).

Discussion

Ultrasonography screening of DDH is recommended for all newborns [16, 17]. However, some guidelines recommend that only newborns with risk factors undergo such screening [18]. If all newborns are screened by ultrasonography, issues, such as an increased use of braces [16] and detection of abnormalities that spontaneously improve [17], can arise. In addition, Biedermann et al. reported that 99.6% of Graf Type I infants at the age of 1 month were Graf Type I at the age of 3 months [19]. Thus, 0.4% of those diagnosed at the age of 1 month may experience subsequent deterioration.

In the present study, ultrasonography screening was only performed for infants with risk factors at the age of 4 months. However, none of the hips diagnosed as Graf Type I at the age of 4 months showed worsening from Type I to ≥Type II at the age of 7 months. None of the patients experienced dislocation at the age of 1 year. The hip joints of infants at the age of 4 months thus appear to have already stabilized. Furthermore, even if there are limitations in abduction and flexion, the Graf classification will not worsen in 4-month-old infants with Graf Type I.

By contrast, when DDH treatment is initiated at the age of 4 months, it may be more difficult to treat compared with treatment started in the neonatal period; however, in all of our patients, treatment was feasible with a Pavlik harness, and there were no subsequent issues. Moreover, although there is a possibility of missing DDH when only infants with risk factors are examined, but our institution is the only institution treating DDH in Nagasaki City and patients with DDH who started walking have not been encountered in the past 5 years. Thus, it is believed that only infants with risk factors should undergo selective ultrasonography screening at the age of 4 months.

The “Guide to hip dislocation in infant health check-ups” published by the Japanese Society of Pediatric Orthopaedic Surgery was created by referring to the so-called Matsudo method. Shinohara performed X-rays in all patients during infancy. The results of this test were evaluated in detail to identify the risk factors of DDH. A method of selective X-rays for infants with appropriate risk factors was devised in 1974. This is called the Matsudo method because it was implemented in Matsudo City [20]. When reporting on the results of this method in 2014, Shinada stated that out of 196,643 patients who were screened during a 41-year period, diagnosis was delayed for 10 patients only [21].

Yamamura et al. stated in 1975 that the mean acetabular index at the age of 1 year was 24.3° in males and 23.1° in females [22], which was not markedly different from our results. In addition, the report stated that the confidence limits of the acetabular angle at a risk of 5% was 30.8° in females and 30.5° in males at the age of 1 year [22]. Our results showed that the acetabular index was 30° in 8.7% of the patients at the age of 1 year. Dornacher et al. stated that there were no significant correlations between the Graf classification and the radiological outcome at follow-up [23]. A diagnosis of acetabular dysplasia was made at the age of 1 year for some patients who were diagnosed with Graf Type I at the age of 4 months, indicating that X-ray testing should be performed at least once.

This study had some limitations. We did not investigate data for all infants born in Nagasaki City, and the follow-up period was relatively short. Even if acetabular dysplasia is diagnosed at the age of 1 year, if the condition improves by the age of 4–5 years, it may not be necessary to perform X-ray testing at the age of 1 year.

Performing selective hip dislocation screening at the age of 4 months did not lead to any refractory cases or delayed diagnoses. At the age of 1 year, no patients had dislocations as per X-ray. However, some patients were diagnosed with acetabular dysplasia.

Abbreviations

DDH Developmental Dysplasia of the Hip

Declarations

Ethics approval and Consent to participate

All procedures in this study were performed in accordance with the ethical standards of the Ethics Committee of Nagasaki University Graduate School of Biomedical Sciences (approval number: 20032322).

This is a retrospective study, so no consent to participate was obtained.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors contributed to conception and design. SM, HM and RT analysed and interpreted the data. All authors participated in the drafting of the manuscript. Finally, all authors received and approved the final version of the submitted manuscript.

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Tables

Table 1. Number referred for secondary hip dislocation examination among births between April 2015 and Mar 2018

In Nagasaki city	n
Number of births	9.517
Primary hip dislocation screening	9.251
Secondary hip dislocation examination	488
Seen at our department	263

Table 2. Graf classification

Type	**n (%)**
I	250 (95.1)
II	9 (3.4)
III	2 (0.8)
IV	2 (0.8)

Table 3. Reasons for referral for secondary hip dislocation examination

Reason for referral	**n (%)**
Limitations of abduction in flexion	130 (49.4)
Asymmetry of skin creases	88 (33.5)
Family history	38 (14.4)
Female infant	193 (73.4)
Breech delivery	27 (10.3)

Table 4. Combination of reasons other than limitations of abduction in flexion alone

Reasons for referral	**n (%)**
Female infant + asymmetry of skin creases	81 (30.8)
Female infant + family history	33 (12.5)
Female infant + breech delivery	23 (8.7)
Asymmetry of skin creases + family history	10 (3.8)
Breech delivery + family history	5 (1.9)
Asymmetry of skin creases + breech delivery	2 (0.8)