

Developmental Dysplasia of the Hip – Epidemiological Determinants and Age Assessment Regarding Time of Surgical Correction

Vývojová dysplázie kyčelního kloubu – epidemiologické určující faktory
a zhodnocení věku vzhledem k době chirurgické léčby

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ABSTRACT

PURPOSE OF THE STUDY

Aim of the study was to analyze age structure of the patients with developmental dysplasia of the hip (DDH) at the time of the operation and epidemiological determinants: gender distribution, proportion of left or right hip affection, type of delivery and mode of labor presentation.

MATERIAL AND METHODS

The population of 78 children with DDH was evaluated. Three age groups were analyzed: first group younger than 24 months of life, second group between 24 and 48 months and third group older than 48 months of life. Male and female gender was separately evaluated as well as type of delivery and mode of labor presentation. Separately, 2 groups regarding affected hip were analyzed: group with affected left hip and group with affected right hip.

Radiographic findings (Collodiaphyseal angle, Hilgenreiner angle and Wibergs center-edge angle) and clinical findings (positive Trendelenburgs sign, reduced flexion angle ($<114^\circ$), pain in the hip and incomplete crouch) were evaluated regarding: age of the patients, gender, mode of presentation and type of delivery.

RESULTS

There was 33.3% of patients in the first age group, 46.2% of patients in second group and 20.5% of patients in third age group, and regarding gender, 17.9% of males and 82.1% of females. Vaginal delivery was predominant mode with distribution of 87.2% as well as head presentation with distribution of 71.8%. Distribution of children with affected left hip was 46.2% and right hip 53.9%.

DISCUSSION

Majority of patients in the study were in the age group between 24 and 48 months of life, suggesting delay in on-time diagnostics of DDH. Female gender was more frequently affected by DDH and vaginal delivery as well as head presentation of newborn was significantly frequent in patients with DDH.

It is shown that Collodiaphyseal, Hilgenreiner and Wibergs center-edge angles values are in correlation with the age structure of the patients with DDH at the time of diagnosis.

Male gender tends more frequently to present with clinical findings. Reduced flexion angle of the hip is the frequent clinical finding for children with DDH that were born by breech presentation or delivered by Caesarean section.

CONCLUSION

Female gender can be taken as one of possible risk factors during clinical examination of newborn regarding diagnostics of DDH, while breech presentation has been shown not to be one of possible risk factors. Early diagnostics and prompt treatment are beneficial in overall outcome for children with DDH. Therefore, there is great need for continuous education of orthopedic surgeons and pediatricians.

Key words: Developmental dysplasia of the hip, age, gender, delivery.

INTRODUCTION

Developmental dysplasia of the hip (DDH) presents as one of the most frequent congenital defects of locomotor apparatus. There are studies stressing out that incidence of DDH in developed countries estimates from 1.5 to 20 in 1000 newborns (13, 2).

Since DDH is congenital in its etiology, numerous authors studied potential links and factors during development that could be in correlation with such condition. One among numerous observations included potential hormonal link (6), while others pointed out that genetics factors could be responsible for development of DDH (3, 5, 9). Such claims regarding inheritance were

postulated by observation of certain families and ethnic groups.

Modern approach stress out importance of early diagnostics and on-time treatment of patients with DDH in order to shorten treatment duration and reduce necessity for surgical intervention (14, 12). It is fact that incorrect treatment of DDH leads to severe invalidity especially in part of patients life when one is expected to be mostly active.

Therefore aim of our study was to analyze age structure of the patients with DDH at the time of the operation and epidemiological determinants for entire evaluated population and within age groups that include: gender distribution of children with DDH, proportion of left or right hip affection, type of delivery and mode of labor presentation.

MATERIALS AND METHODS

Study group

We evaluated 78 children that were diagnosed with DDH and treated at the Orthopedic Department at University childrens Hospital in Belgrade during 12 years period. All children were completely assessed clinically with adequate diagnostic evaluation in order to confirm diagnosis. Those children older than 3 months of life were assessed radiographically beside positive sonographic findings (15). Due to the age structure all patients were divided into 3 groups: first group included evaluated population younger than 24 months of life, second group consisted of patients between 24 and 48 months of life and third group included older than 48 months of life population. Within age groups we evaluated mean age at the time of the operation. Regarding gender all patients were classified into 2 groups: males and females. Due to the type of delivery, children were divided into two groups: vaginal delivery and Caesarean section, while due to the mode of labor presentation patients were divided into 2 groups: group with breech presentation and group with head presentation. In order to evaluate distribution and correlation of left and right hip affection we analyzed 2 groups: group of children with affected left hip and group of children with affected right hip. Children with bilateral DDH were excluded from the study.

Radiographic findings (Collodiaphyseal angle, Hilgenreiner angle and Wibergs center-edge angle) and clinical findings (positive Trendelenburgs sign, reduced flexion angle in the hip ($<114^\circ$), pain in the hip and incomplete crouch) were evaluated due to age structure at the time of diagnosis, gender, mode of presentation at the labor and type of delivery.

Statistical analysis

We used mean value with standard deviation (SD) to present age structure in defined age groups of participants. Distribution of children in every age group was presented by whole numbers (N) and percents (%), as well as gender proportion, side of affected hip and distribution of patients in every group due to the type of deli-

very and mode of labor presentation. Radiographic findings were presented as median with standard deviation, while clinical findings were presented as whole numbers (N) and percents (%). In order to estimate correlation between frequencies of different age groups we used chi-square test. To determine statistical significance between genders, sides of hip affection, types of delivery and modes of presentation at the labor we used chi-square test. For comparison of evaluated angles median values between age groups we used ANOVA test, while for comparison between genders, modes of presentation and types of delivery we used students t-test. To compare male/female gender, breech/head presentation and caesarean/vaginal delivery proportions regarding presence of clinical findings we used chi-squared test.

RESULTS

Our study evaluated 78 children that were diagnosed with DDH and treated at University children's Hospital in Belgrade during 12 years period. In the group of children younger than 24 months of life we had 26 (33.3%) patients, in the group between 24 and 48 months of life we had 36 (46.2%) patients and in third age group we had 16 (20.5%) patients. There is statistical difference when first and second age groups are compared as well as when first and third age groups are compared ($p<0.05$), while there is significant statistical difference ($p<0.01$) when frequency of evaluated population in second age group is compared with one from third age group.

Mean age of patients at the time when diagnosis of developmental dysplasia of the hip was confirmed was 7 months with age interval from 1 month to 98 months (Tab. 1).

Our study pointed out that female gender was significantly frequently more affected, while DDH on right hip was frequent but not significantly (Tab. 2).

Among children that were treated due to developmental dysplasia of the hip, predominant mode of presentation at delivery was by head with significant statistical difference in second and third age groups as well

Tab. 1. Mean age with minimal and maximal values at defined age groups at the time of the operation

| Age groups | Mean \pm SD (months) | Minimal value (months) | Maximal value (months) |
|--------------|------------------------|------------------------|------------------------|
| First group | 14.5 \pm 6.8 | 1 | 24 |
| Second group | 32.8 \pm 4.5 | 25 | 41 |
| Third group | 68.5 \pm 18.2 | 50 | 98 |

Tab. 2. Gender and affected hip distribution. * $p<0.01$

| Age groups | Gender | | Affected hip | |
|--------------|------------|--------------|--------------|-------------|
| | Male N (%) | Female N (%) | Left N (%) | Right N (%) |
| First group | 2 (2.6) | 24 (30.8)* | 12 (15.4) | 14 (18.0) |
| Second group | 6 (7.7) | 30 (38.5)* | 16 (20.5) | 20 (25.6) |
| Third group | 6 (7.7) | 10 (12.8) | 8 (10.3) | 8 (10.3) |
| Total | 14 (17.9) | 64 (82.1)* | 36 (46.2) | 42 (53.9) |

as for total evaluated group while vaginal delivery was predominant type of delivery (Tab. 3).

Radiographic finding of 3 hip angles (Collodiaphyseal angle, Hilgenreiner angle and Wibergs center-edge angle) pointed out that there is significant change in the values of observed parameters regarding participants age at the time of diagnosis, while there wasn't observed significant change in the values of evaluated angles between genders, evaluated mode of presentation and type of delivery (Tab. 4).

Positive Trendelenburgs sign was present in children older than 48 months of life at the time of diagnosis. Same observation applies for the presence of the pain in the hip. In the study, positive Trendelenburgs sign was noticed only in female population, while pain in the hip was significantly more frequent in the male population. Incomplete crouch was significantly frequent in individuals born by head presentation, while other 3 clinical findings were significantly frequent in those born by breech presentation. Reduces flexion angle in the hip was significantly more present in the group born by caesarean section, while incomplete crouch was significantly frequent in those born by vaginal delivery (Tab. 5).

DISCUSSION

Developmental dysplasia of the hip is among the most common congenital skeletal diseases (7). It is estimated that 75% of all congenital defects are newborns with DDH (8). However there are wide discrepancies between

reports regarding real incidence over different periods of time (15). Therefore there is great need for its attention especially in early period of life, since it can be successfully treated if diagnosed early preferably in neonatal period (10). Clinical examination performed by experienced practitioners along with ultrasound examination shown to give excellent results in diagnostics of children with DDH (4).

Our results pointed out that majority of patients with DDH, almost every second patient, were in the age group between 24 and 48 months of life. Such findings from our survey suggest delay in on-time diagnostics of DDH. There are studies stressing out that hips in newborns should be screened with re-examination at 2 weeks, 2 months, 4 months, 6 months, 9 months, and 12 months of age (1). This model of follow-up will ensure timely diagnosis and prompt treatment.

We have demonstrated that female gender is more frequently affected by DDH that is in correlation with other conducted epidemiological studies regarding developmental dysplasia of the hip (11,16). Further it is observed by our findings that female gender is statistically frequently affected in first and second age group, while in the age group above 48 months of life we found no statistical difference even though female gender was frequently affected.

Even though there are epidemiological studies stressing out dominant affection of the left hip (16), in our study we have found that there is not statistical difference in side of hip affection.

Regarding type of delivery vaginal mode was predominant form of delivery for children with DDH. It is shown that for every evaluated age group above mentioned type of delivery was predominant, with almost every second child been of age between 24 and 48 months, every fourth younger than 24 months and every fifth older than 48 months of life. It should be noticed that we had no patients born by caesarean section older than 48 months of life.

Our results pointed out that head presentation as mode of delivery during labor was significantly statistically frequent for patients that were diagnosed with DDH. Such statistical significance in our study applies to those child-

Tab. 3. Mode of labor presentation and type of delivery distribution. * p<0.01

| Age groups | Mode of presentation | | Type of delivery | |
|--------------|----------------------|------------|------------------|---------------|
| | Breech N (%) | Head N (%) | Caesarean N (%) | Vaginal N (%) |
| First group | 10 (12.8) | 16 (20.5) | 6 (7.7) | 20 (25.6)* |
| Second group | 10 (12.8) | 26 (33.3)* | 4 (5.1) | 32 (41.0)* |
| Third group | 2 (2.6) | 14 (17.9)* | 0 (0.0) | 16 (20.5)* |
| Total | 22 (28.2) | 56 (71.8)* | 10 (12.8) | 68 (87.2)* |

Tab. 4. Comparison of radiological findings due to evaluated parameters. * p<0.01

| Evaluated parameters | | Radiographic X rays findings | | |
|----------------------|-----------|------------------------------|--------------------|--------------------------|
| | | Collodiaphyseal angle | Hilgenreiner angle | Wibergs center-age angle |
| | | Mean ± SD | Mean ± SD | Mean ± SD |
| Age group | First | 156.24±10.31 | 36.07±5.95 | 9.43±7.36 |
| | Second | 143.84±8.65 | 37.94±7.03 | -4.03±15.17 |
| | Third | 146.62±9.62 | 29.32±7.12 | 11.06±5.96 |
| ANOVA (F value) | | 13.48* | 9.26* | 14.58* |
| Gender | Male | 148.47±8.61 | 34.26±6.19 | 7.38±8.23 |
| | Female | 147.12±9.17 | 35.63±6.24 | 8.06±8.19 |
| t-test (p value) | | 0.62 | 0.46 | 0.78 |
| Mode of presentation | Breech | 146.32±7.96 | 34.11±6.12 | 7.42±7.46 |
| | Head | 148.86±8.29 | 36.02±6.35 | 7.93±8.02 |
| t-test (p value) | | 0.22 | 0.23 | 0.80 |
| Type of delivery | Caesarean | 149.47±8.12 | 36.74±6.62 | 5.24±6.07 |
| | Vaginal | 147.02±7.86 | 34.06±6.17 | 8.14±8.37 |
| t-test (p value) | | 0.36 | 0.21 | 0.30 |

Tab. 5. Comparison of clinical findings due to evaluated parameters. * p<0.01

| Evaluated parameters | | Clinical findings | | | |
|----------------------|-----------|--------------------------------|--------------------------------|-----------------|-------------------|
| | | Trendelenburgs sign (positive) | Reduced flexion angle (≤ 114°) | Pain in the hip | Incomplete crouch |
| | | N (%) | N (%) | N (%) | N (%) |
| Age group | First | 0 (0.0) | 4 (5.1) | 0 (0.0) | 4 (5.1) |
| | Second | 0 (0.0) | 2 (2.6) | 0 (0.0) | 2 (2.6) |
| | Third | 2 (2.6) | 6 (7.7) | 4 (5.1) | 4 (5.1) |
| Gender | Male | 0 (0.0) | 3 (21.4) | 2 (14.3) | 2 (14.3) |
| | Female | 2 (3.1) | 9 (14.1) | 2 (3.1)** | 8 (12.5) |
| Mode of presentation | Breech | 2 (9.1) | 7 (31.8) | 2 (9.1) | 1 (4.5) |
| | Head | 0 (0.0)* | 5 (8.9)** | 2 (3.6)* | 9 (16.1)** |
| Type of delivery | Caesarean | 0 (0.0) | 6 (60.0) | 0 (0.0) | 0 (0.0) |
| | Vaginal | 2 (2.9) | 6 (8.8)** | 4 (5.9) | 10 (14.7)** |

ren that are older than 24 months of life, since we found non statistical difference from those that were younger than 24 months of life. These findings are in correlation with other studies that were conducted regarding such parameter (11). Among those patients that were born with breech presentation the least frequent were children in the group above 48 months of life, while those with head presentation at the time of delivery had non statistically significant difference between first and third age group with second age group as mostly frequent.

It is stressed out in our study that age of the patients with DDH is important factor in the evaluation of radiographic parameters, since angle values differ between age groups with the lower values for Collodiaphyseal and Wibergs center-edge angle in the second age group and for Hilgenreiner angle in the third age group. However, when compared, other parameters: gender (male and female), mode of presentation (breech presentation and head presentation) and type of delivery (Caesarean section and Vaginal delivery) showed not significant difference in the average values of evaluated angles.

We have demonstrated that as children with DDH are older at the time of diagnosis, they have greater chance to present with positive Trendelenburgs sign, reduced flexion angle of the hip ($<114^\circ$) and with the pain in the hip. However, incomplete crouch in those younger than 24 months of life can be explain by instability due to the maturation of the center for balance. Also we have observed that male gender tends frequently to present with reduced flexion angle of the hip, pain in the hip or incomplete crouch. Therefore presence of clinical findings in male population will strongly point out the possibility of DDH.

From the results of our study, breech presentation closely correlate with hip flexion angle, since, almost every third child with DDH that was born by breech presentation was noticed to have reduced flexion angle below 114° in the hip. Further, reduced flexion angle in the hip is present in more than a half of the children with DDH that were delivered by Caesarean section.

CONCLUSION

Our findings demonstrated that female gender can be taken as one of possible risk factors during clinical examination of newborn regarding diagnostics of DDH, while breech presentation has been shown not to be one of possible risk factors regarding DDH. Age of the participants closely correlate with the values of hip angles on radiographic presentation as well to the presence of the clinical finding. Male gender tends more frequently to present with clinical findings, while reduced flexion angle of the hip is more frequently seen in children with DDH born by breech presentation or delivered by Caesarean section. Since mean age of DDH confirmation in our study was 7 months of life, there is great need for continuous education of primary care physicians, orthopedic surgeons and pediatricians in order to lower the age trend to justified period for adequate treatment that could give optimal results.

References

1. ARONSSON, D. D., GOLDBERG, M. J., KLING, T.F. JR., ROY, D. R.: Developmental dysplasia of the hip. *Pediatrics*, 94: 201–208, 1994.
2. BIALIK, V., BIALIK, G. M., BLAZER, S., SUJOV, P., WIENER, F., BERANT, M.: Developmental dysplasia of the hip: a new approach to incidence. *Pediatrics*, 103: 93–99, 1999.
3. BURIAN, M., DUNGL, P., CHOMIAK, J., OŠTÁDAL, M., FRYDRYCHOVÁ, M.: Efficiency of Conservative Treatment by Overhead Traction in Developmental Dysplasia of the Hip. *Acta Chir. orthop. Traum. čech.*, 77: 371–377, 2010.
4. FINNE, P. H., DALEN, I., IKONOMOU, N., ULIMOEN, G., HANSEN, T. W.: Diagnosis of congenital hip dysplasia in the newborn. *Acta. Orthop.*, 79: 313–320, 2008.
5. FORSDAHL, A.: Finnmarslegen som påviste arvens betydning ved hoftelddysplasi. *Tidsskr. Nor. Laegeforen.*, 120: 2672–2673, 2000.
6. FORST, J., FORST, C., FORST, R., HELLER, K. D.: Pathogenetic relevance of the pregnancy hormone relaxin to inborn hip instability. *Arch. Orthop. Trauma. Surg.*, 116: 209–212, 1997.
7. IHME, N., SCHMIDT-ROHLFING, B., LORANI, A., NIETHARD, F. U.: Nonsurgical treatment of congenital dysplasia and dislocation of the hip. *Orthopade*, 32: 133–138, 2003.
8. KOKAVEC, M., BIALIK, V.: Developmental dysplasia of the hip. Prevention and real incidence. *Bratisl. Lek. Listy*, 108: 251–254, 2007.
9. MABUCHI, A., NAKAMURA, S., TAKATORI, Y., IKEGAWA, S.: Familial osteoarthritis of the hip joint associated with acetabular dysplasia maps to chromosome 13q. *Amer. J. Hum. Genet.*, 79: 163–168, 2006.
10. MACEWEN, G. D., MILLET, C.: Congenital dislocation of the hip. *Pediatr. Rev.*, 11: 249–252, 1990.
11. MIRDA, T.: Incidence and pattern of congenital dislocation of the hip in Aseer region of Saudi Arabia. *West. Afr. J. Med.*, 21: 218–222, 2002.
12. PACH, M., KAMÍNEK, P., MIKULÍK, J.: Wagnerovy punčošky v léčbě vývojové dysplazie kyčelního kloubu, časné diagnostikované v rámci všeobecného skríninku *Acta Chir. orthop. Traum. čech.*, 75: 277–281, 2008.
13. PATEL, H.: Canadian Task Force on Preventive Health Care. Preventive health care, 2001 update: screening and management of developmental dysplasia of the hip in newborns. *CMAJ*, 164: 1669–1677, 2001.
14. SYNDER, M., HARCKE, H. T., DOMZALSKI, M.: Role of ultrasound in the diagnosis and management of developmental dysplasia of the hip: an international perspective. *Orthop. Clin. North. Amer.*, 37: 141–147, 2006.
15. TUDOR, A., SESTAN, B., RAKOVAC, I., LUKE-VRBANIĆ, T. S., PRPIĆ, T., RUBINIĆ, D., DAPIĆ, T.: The rational strategies for detecting developmental dysplasia of the hip at the age of 4–6 months old infants: a prospective study. *Coll. Antropol.*, 31: 475–481, 2007.
16. VENCÁLKOVÁ, S., JANATA, J.: Souborné zhodnocení screeningu vývojové dysplazie kyčelního kloubu v regionu Liberec za období 1984–2005. *Acta Chir. orthop. Traum. čech.*, 76: 218–224, 2009.

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