Praca oryginalna *Original paper*

Use of distraction radiography in canine hip dysplasia: comparison of early and late results with two different distractors

EROL GUCLU GULANBER, NUSRET GURKAN GULANBER, NUR REYHAN ALBAYRAK, KURSAT OZER*, MUSTAFA AKTAS*, OZGUR AKSOY**

G&G Academia Animal Hospital, Menekseli sok. No.14; 1st Levent; 34330 Istanbul, Turkey
*Department of Surgery, Faculty of Veterinary Medicine, Istanbul University, Avcılar, Istanbul, Turkey
**Department of Surgery, Faculty of Veterinary Medicine, Kafkas University, Kars, Turkey

Gulanber E. G., Gulanber N. G., Albayrak N. R., Ozer K., Aktas M., Aksoy O.

Use of distraction radiography in canine hip dysplasia: a comparison of early and late results with two different distractors

Summary

In recent years, radiologic detection of passive joint laxity, i.e., distraction radiography, has become important in the early diagnosis of hip dysplasia in dogs. In this study, Ortolani Diagnosis and Distraction Index (DI), i.e., radiographic passive joint laxity, were determined for 122 dogs between 3- and 9-months-of-age, and this data was compared with adult period control radiographies (the period after 18-months-of-age). By this means an attempt was made to determine the relation between DI and Ortolani diagnosis, Norberg angle and Federation Cynologique Internationale (FCI) classification. A high correlation was established between the results taken by two types (PennHip and wooden lath) of distractors. Although no correlation was found between breed, age, sex, body weight and DI measurement, a significant correlation was found between DI measurement and FCI classification and Norberg angles after the age of 18 months. On the other hand, no significant correlation was found between Ortolani diagnosis and DI measurement and FCI-Norberg data after the age of 18 months. Consequently, the usage of distraction radiography was observed to be more effective than other clinical and radiographic methods in the early diagnosis of hip dysplasia in dogs.

Keywords: distraction radiography, PennHip, hip dysplasia, dog

Dysplasia of the coxofemoral joint (hip) in dogs is a hereditary, developmental abnormality that characteristically begins with subluxation and laxity and leads to osteoarthritis. Canine Hip Dysplasia (CHD) is not manifested at birth, but becomes evident later in life and increases severily with advancing age. The most critical period upon the development of hip dysplasia is between three and eight months of age, the time of important growth and development of the hip (8, 11, 26).

CHD is still the most common orthopedic problem. It is an area of frequent dispute between breeders and pet owners. Early detection of CHD is beneficial in implementing selective breeding programs to reduce the breed-specific incidence of CHD (6-9, 15).

CHD can be tentatively diagnosed based on palpation findings, the patient history, and clinical signs. However, a definitive diagnosis requires radiographic identification of hip joint laxity or secondary morphometric and degenerative changes within the joint (8, 12).

In younger dogs, laxity of the hip joint can be detected by checking for Ortolani's sign or Bardens' sign. Not all dogs with hip dysplasia will have palpable joint laxity (6, 8, 17, 26).

Although fairly new diagnostic modalities (e.g., computed tomographic scanning, ultrasonography, magnetic resonance imaging, force plate, kinematics, molecular techniques) are currently under investigation, radiography has become the accepted convention for the diagnosis of CHD (8, 14).

Recent developments in the evaluation of dogs for CHD have focused on radiographic methods, such as Distraction index (DI), for detecting passive coxofemoral joint laxity. This method incorporates a stress-radiographic view with the dog in ventrodorsal position. A custom-designed, adjustable distractor device is used to cause maximal lateral displacement of the femoral heads. An index measurement method the distraction index, quantifies the relative degree of passive hip joint laxity. This distraction technique has been developed commercially (The University of Pennsylvania Hip Improvement Program, or „PennHip" method). Smith and others showed that the distraction index at four months of age was highly correlated with the DI at 24 months and was associated with the resemblance that dogs would develop radiographic evidence of CHD (1-5, 10, 16, 18-25, 27).

On the other hand, other distractor types were used by some researchers. PennHip and lath method were clinically reliable techniques in predicting true negatives. Also a modified distractor was used by Vezzoni (2, 5, 15).

The distraction radiograph quantifies the relative degree of femoral head displacement from the acetabulum by calculating the DI. The DI ranges from 0 to > 1, with 0 representing full congruency of the hip joint and 1 representing complete luxation. The standard, ventrodorsal, hip-extended radiographic projection is included as part of the PennHip analysis, because this radiographic view provides pertinent information as to the presence and severity of DJD (8, 15, 25).

The purpose of this study is to determine the relation between DI using two types of distractors and Ortolani Diagnosis and Norberg angle data belonged to the control radiographies and FCI classification in the adult period.

Material and methods

This study was performed with 185 dogs that were brought to our clinic between the years 2001 and 2004 and they were predisposing breeds to hip dysplasia. Subjects were called to be controlled in a period of ages between 18 months and 3 years. Because of the reasons such as distance and time lack of the owners of the dogs, they couldn't have brought their dogs to our hospital at the desired ages, so the controls have not been held at a specific age. Furthermore, due to reasons like sale or switching to new owners of some dogs, those controls couldn't have been done and for these reasons only 112 dogs and their 224 hip joints were evaluated.

All the dogs were taken under general orthopedic inspections and checked whether any clinic lameness, pain, X or O legged deformations were present or not. Hip joint palpation and radiologic studies were done under anesthesia. A 5 mg/kg doze of propofol (Propofol ampule – 200 mg/20 ml. – Fresenius Kabi) was used for anesthesia as continuous intravenous.

The state of coxofemoral laxity was determined by Ortolani's sign. For Ortolani's sign the femur was positioned at a 90° angle to the long axis of the pelvis and the stifle was adducted. A dorsally directed force was applied to the stifle to elicit subluxation and the stifle was then slowly abducted to achieve reduction of the hip joint. Dogs were considered to have an Ortolani sign, if a palpable clunk was felt or an audible thunk was heard during hip joint palpation. Results were classified as positive and negative.

In radiologic study, 50 mA x-ray device and automatic film processor were used. X-ray films were taken in three positions. These positions were distraction view, compression view and VD view, in which legs were stretched. Distraction and compression positions were x-rayed using both PennHip distractor and wooden lath distractor. The films, which were defective or had any cavities, were taken again. In these x-rays, Distraction Index, Compression Index and Norberg angle measurements were done.

For the distraction views, dogs were maintained in dorsal recumbency. Either the PennHip or the wooden lath („V" shaped) distractor was placed between the legs and an assistant firmly pressed the device down onto the pelvis. While grasping the hocks, the examiner held the knees at approximately 90° flexion and pushed them together, using the device as a fulcrum to impose a lateral distractive force on the hip joints. The width of the PennHip distractor or the wooden lath was set at approximately the interacetabular distance. The lath was of a trapezoid shape, as described by Badertscher (2, 15, 27), to enable correct adjustment to the width of the pelvic floor. For Compression views, PennHip distractor or wooden lath distractor were positioned between the legs, while dogs were in dorsal recumbency. The Compression view radiography was taken in legs open position, while the distractor was pressed towards the femur and the knee was pressed from the lateral towards medial. Both in compression and distraction view radiographies for radiographic quantitation of hip joint laxity, the geometric centers of the femoral head and acetabulum were determined. The DI was derived by dividing the distance between both geometric centers by the radius of the femoral head (8).

The Norberg angle used to assess joint laxity is defined by two straight lines originating from the centre of the femoral head; the first tangential to the craniolateral rim of the acetabulum and the second connecting the centre of the contralateral femoral heads (12, 13).

The subjects were called for control at the age of 18 months. But because of the reasons mentioned before, VD view radiography was taken in legs stretched position on the dogs of various ages over 18 months, which were brought for the control. On those radiographies, classification according to FCI criteria (13) and Norberg angle measurements were done (tab. 1).

Dogs were classified in respect of their ages, breeds and sex for a statistical study. The cases were grouped according to their ages. The groups were as follows: 8-12 weeks old, 3.5-4 months old, 4.5-5 months old, 5.5-6 months old, 7-8 months old, 8.5 and more months old. The measurements and data were expressed as mean ± SD and median. The obtained data were evaluated with linear regression analysis and ANOVA, using the computer software GraphPAD Prism (GraphPad Software Version 4) and GraphPAD InStat (GraphPad Software Version 3). Differences were considered significant at $p < 0.05$.

Tab. 1. Grading scores for hip dysplasia according to FCI (10)

Grade	Radiological findings
A No signs of hip dysplasia	The femoral head and the acetabulum are congruent and the Norberg angle is 105° or more. The craniolateral rim appears sharp and slightly rounded. The joint space is narrow and even. In excellent hip joints the craniolateral rim encircles the femoral head somewhat more in a laterocaudal direction.
B Transitional or borderline hip joints	The femoral head and the acetabulum are slightly incongruent and the Norberg angle is 10° or more, or the Norberg angle is less than 105° and the femoral head and the acetabulum are congruent.
C Mild hip dysplasia	The femoral head and the acetabulum are incongruent, the Norberg angle is more than 100° and/or there is a slightly flattened craniolateral rim. Irregularities or no more than slight signs of osteoarthrotic changes of the cranial, dorsal or caudal acetabular margins or on the femoral head and neck may be present.
D Moderate hip dysplasia	Obvious incongruency between the femoral head and the acetabulum with subluxation. The Norberg angle is more than 90° (only as a reference). Flattening of craniolateral rim and/or osteoarthrotic signs are present.
E Severe hip dysplasia	Marked dysplastic changes of the hip joints, such as luxation or distinct subluxation. Norberg angle is less than 90°, obvious flattening of the cranial acetabular margin, deformation of the femoral head (mushroom shaped, flattening) or other signs of osteoarthrosis.

Results and discussion

Dogs were of various ages between 3 and 9 months, and of various sizes between 10 kg and 35 kg body weight. The population included 68 males and 44 females (36 Golden Retrievers, 28 Labrador Retrievers, 16 Turkish Shepherd Dogs (Kangal), 12 German Shepherd dogs, 8 Rotweiller, 4 Mastiff, 2 Boxer, 2 Great Dane, 1 Doberman, 1 PitBull, 1 Saint Bernard and 1 Siberian Husky).

It was observed that, for distraction radiography, administering propofol anaesthesia as continuous infusion provided adequate muscle relaxation.

By reason of cavitations, radiographies were renewed for 27 subjects out of 122, while 4 defective radiographies were repeated.

No orthopedic deformations were found for 122 subjects that were taken into evaluation. Only in 21 subjects, symptoms such as clinical lameness or quick tiredness were determined. Statistically, no significant correlation was established between clinical symptoms and DI measurement ($r = 0.0858$, $p = 0.6835$).

Ortolani symptom was determined positive for 16 subjects out of 122. The correlation between the DI measurement and the Ortolani symptom of the subjects was not found significant ($r = -0.1344$, $p = 0.4485$). Moreover, statistically no significant correlation were established between the hip joint palpation that was done in the early period and the Norberg angle measurement in the late period control radiographies ($r = -0.1689$, $p = 0.3397$).

Statistically, no significant correlation was determined between breed, age, sex and body weight and the DI measurement. On the other hand, statistically, a high correlation was found between the DI measurement as to age groups and the Norberg angle measurements in control radiographies except for the 12 weeks age period.

In addition to those, the correlation between the Norberg angle measurements in the control radiographies and the VD radiographies taken in the early period was not statistically significant.

Between the PennHip and Lath distractor; the mean, standard deviation and median of DI measurements obtained were very similar for the right and left hip joints. They were almost identical in the two methods. A high correlation was found between PennHip and Lath DI ($r = 0.9732$, $p < 0.0001$) (tab. 2).

In the DI measurement between FCI groups, no statistical difference was found between A and B groups and D and E groups. However, difference between the other groups was statistically significant ($p < 0.0001$). Also, a correlation was found between the DI measurement of FCI groups and the Norberg angle measurements in the late period control radiographies (tab. 3).

Although the results obtained from the two distractors used in our study were the same as other researcher (15, 27), it was observed that the „V" shaped wooden lath distractor was practical for usage easiness and an inexperienced veterinary surgeon could be adapted to this distractor more easily. It was simpler for the user to adjust and position the distractor according to the patient and there was no time loss. During distraction, since the wooden edges of the lath distractor were sharp, it was leaving marks and causes redness on the skin of the femur medial as a disadvantage. At first, to prevent this, the edges of the lath distractor were strapped using bandage material. But, afterwards, by rounding the edges of the lath distractor, this disadvantage was completely eliminated.

Tab. 2. Means, DI with PennHip and Lath distractor in the left and right hip joints

Distractor type and DI	Mean	SD	Median
PennHip DI right	0.53	0.19	0.50
PennHip DI left	0.54	0.19	0.50
Lath DI right	0.53	0.19	0.50
Lath DI left	0.53	0.17	0.50

Tab.3. According to the FCI classification of cases of DI (in early period) and Norberg Angle (in late period)

FCI	DI			Norberg Angle		
	Mean	SD	Median	Mean	SD	Median
A (n = 80)	0.41	0.08	0.40	115.40	4.21	117
B (n = 68)	0.48	0.11	0.50	105.40	3.74	105
C (n = 36)	0.61	0.19	0.55	101.50	3.71	101
D (n = 28)	0.86	0.09	0.85	92.67	5.62	92
E (n = 12)	0.89	0.09	0.90	84.00	4.18	85

Despite having no problems in propofol anesthesia during distraction radiography, the increase in the amount of propofol administered as continuous infusion in case of renewing the radiographies because of defective films or cavitations was resulting in the anesthesia not being economical. Having using the xylazine-ketamine combination anesthesia in clinical practice out of study, we might say, that no big advantage of propofol anesthesia was observed as generally compared. For this reason, in clinical practice, xylazine-ketamine anesthesia is thought to be more suitable for distraction radiography, as it is both economical and more practical in application.

Our opinion is that the cavitation problem in distraction radiography is related to experience. The cavitation problem encountered very often in the beginning of the study was not occurred afterwards. The reason for that was completely experience. Yet, considerable differences between DI measurements of right and left coxafemoral joints at the beginning of the study were completely related to experience. During distraction application, not doing the both legs symmetrically and equally was causing DI to be measured high on one side and low on the other. To prevent this, we believe that, having radiographies on DI position twice for the same patient would reduce the mistakes for those who are new in practice.

For accurate measurements, it is required to have a good radiographic take and sufficient film contrast. Insufficient contrast makes it harder to locate, especially the circular center of acetabulum. Therefore, devices to be used for distraction radiography have to have at least 50 mA power. Furthermore, it would be better to use automatic film development equipment to standardize the films. To be able to evaluate hip dysplasia and hip joint condition in adult period more accurately and objectively FCI classification, which is not commonly used in our country, was used as well. It was seen that, having a high correlation with DI, FCI classification would also be a correct option for particular production purposed selections of adult dogs.

It was observed, that Norberg angle measurement, which is a stand-alone evaluation method that most clinicians have to recourse in their early ages, changed in late period in our study. Yet, having a meaningful relation between early period DI and late period Norberg angle measurements indicates the accuracy of early period distraction radiography evaluation and the necessity of leaving early period Norberg angle measurement.

Despite Ortolani diagnosis is showing parallelism to both DI and FCI classification, it is seen, that it does not fully overlap with them. Determining no statistical relation between „positive Ortolani observed cases in the early period" and „Norberg and DI in the early period" and „Norberg angle in the late period" indicates, that the Ortolani diagnosis can not always be completely established by a clinician and is not the only one determining criterion for the presence or the absence of dysplasia. Therefore, in our opinion, clinicians should not diagnose dysplasia by Ortolani only.

In this study, it was determined that, the DI in 12 weeks age period, which other researchers (2, 12, 24, 25) also informed about, was not an indication of Degenerative Joint Disorder in the adult age period.

In our study, it was observed, that the average DI of some breeds was higher as other researchers (8, 11, 21) informed about. But contrary to expectations, no connection was established between body weight and DI. For this reason, it was realized, that a certain prejudice like „Puppies with more body weight might have dysplasia" could not be true. Just like other researchers (16), we didn't establish a statistical relation between sex of the subjects and DI.

Conclusion

In conclusion, distraction radiography method, which the hip joint laxity of dogs could be evaluated more objectively with, should be used more widely in veterinary practice. Especially in dog production and for duty dogs of both military and civil use, evaluating the hip joints using this method will be an economical benefit. Plus, dogs will have a more healthy life and the dog owners will be protected from the financial aspect and stress of more severe and risky operations.

References

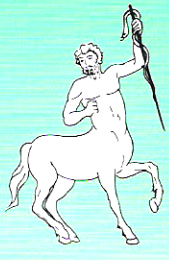
1. *Adams W. M., Dueland R. T., Daniels R., Fialkowski J. P., Nordheim E. V.*: Comprasion of two palpation, four radiographic and three ultrasound methods for early detection of mild to moderate canine hip dysplasia. Vet. Radiol. Ultrasound. 2000, 41, 484-490.
2. *Adams W. M., Dueland R. T., Meinen J., O'Brien R. T., Giuliano E., Nordeheim E. V.*: Early detection of canine hip dysplasia: comprasion of two palpation and five radiographic methods J. Am. Anim. Hosp. Assoc. 1998, 34, 339-347.
3. *Adams W. M.*: Radiographic diagnosis of hip dysplasia in the young dogs. Vet. Clin. North Am. Small Anim. Pract. 2000, 30, 267-280.
4. *Farese J. P., Lust G., Williams A. J., Dykes N. L., Todhunter R. J.*: Comparison of measurements of dorsolateral subluxation of the femoral head and maximal passive laxity for evaluation of the coxofemoral joint in dogs. Am. J. Vet. Res. 1999, 60, 1571-1576.
5. *Gutbrod F.*: Früherkennung der Hüftgelenksdysplasie. Kleintiermedizin 1999, 1, 26-27.
6. *Heyman S. J., Smith G. K., Cofone M. A.*: Biomechanical study of the effect of coxofemoral positioning on passive hip joint laxity in dogs. Am. J. Vet. Res. 1993, 54, 210-215.
7. *Ivanusa T., Pogacnik M.*: Radiological Diagnostics and Forensic of Canine Hip Dysplasia. Slov. Vet. Res. 2001, 38, 305-318.
8. *Kapatkin A. S., Fordyce H. H., Mayhew P. D., Smith G. K.*: Canine hip dysplasia: The disease and it's diagnosis. Compend. Cont. Educ. Pract. 2002, 24, 526-537.
9. *Kapatkin A. S., Mayhew P. D., Smith G. K.*: Genetic control of canine hip dysplasia. Compend. Cont. Educ. Pract. 2002, 24, 681-687.
10. *Lust G., Todhunter R. J., Erb H. N., Dykes N. L., Williams A. J., Burton-Wurster N. I., Farese J. P.*: Comparison of three radiographic methods for diagnosis of hip dysplasia in eight-month-old dogs. J. Am. Vet. Med. Assoc. 2001, 219, 1242-1246.
11. *Lust G., Wiliams A. J., Burton-Wurster N., Pijanowski G. J., Beck K. A., Rubin G., Smith G. K.*: Joint laxity and it's association with hip dysplasia in Labrador Retrievers. Am. J. Vet. Res. 1993, 54, 1990-1999.
12. *Mclaughlin R., Tomlinson J.*: Radiographic Diagnosis of Canine Hip Dysplasia. Vet. Med. 1996, 91, 36-47.
13. *Meomartino L., Fatone G., Potena A., Brunetti A.*: Morphometric assessment of the canine hip joint using the dorsal acetabular rim view and the centre-edge angle. J. Small Anim. Pract. 2002, 43, 2-6.
14. *O'Brien R. T., Dueland R. T., Adams W. C., Meinen J.*: Dynamic ultrasonographic measurements of passive coxofemoral joint laxity in puppies. J. Am. Anim. Hosp. Assoc. 2001, 33, 275-281.
15. *Ohlerth S., Busato A., Rauch M., Weber U., Lang J.*: Comparison of three distraction methods and conventional radiography for early diagnosis of canine hip dysplasia. J. Small Anim. Pract. 2003, 44, 524-529.
16. *Popovitch C. A., Smith G. K., Gregor T. P., Shofer F. S.*: Comparison of susceptibility for hip dysplasia between Rottweilers and German Shepherd Dogs. J. Am. Vet. Med. Assoc. 1995, 206, 648-650.
17. *Puerto D. A., Smith G. K., Gregor T. P., LaFond E., Conzemius M. G., Cabell L. M., McKelvie P. J.*: Relationships between results of the Ortalani method of hip joint palpation and distraction index, Norberg angle, and hip score in dogs. J. Am. Vet. Med. Assoc. 1999, 214, 497-501.
18. *Smith G. K., Gregor T. P., Rhodes W. H., Biery D. N.*: Coxofemoral joint laxity from distraction radiography and it's contemporaneous and prospective correlation with laxity, subjective score, and evidence of degenerative joint disease from conventional hip-extended radiography in dogs. Am. J. Vet. Res. 1993, 54, 1021-1042.
19. *Smith G. K., Hill C. M., Gregor T. P., Olson K.*: Reliability of the hip distraction index in two month-old German shepherd dogs. J. Am. Vet. Med. Assoc. 1998, 212, 1560-1563.
20. *Smith G. K., LaFond E., Gregor T. P., Lawler D. F., Nie R. C.*: Within-and between-examiner repeatability of distraction indices of the hip joints in dogs. Am. J. Vet. Res. 1997, 58, 1076-1077.
21. *Smith G. K., Mayhew P. D., Kapatkin A. M., McKelvie P. J., Shofer F. S., Gregor T. P.*: Evaluation of risk factors for degenerative joint disease associated with hip dysplasia in German shepherd dogs, Golden Retrievers, Labrador Retrievers, and Rotweillers. J. Am. Vet. Med. Assoc. 2001, 219, 1719-1724.
22. *Smith G. K., Popovitch C. A., Gregor T. P., Shofer F. S.*: Evaluation of risk factors for degenerative joint disease associated with hip dysplasia in dogs. J. Am. Vet. Med. Assoc. 1995, 206, 642-647.
23. *Smith G. K.*: Advances in diagnosing canine hip dysplasia. J. Am. Vet. Med. Assoc. 1997, 210, 451-1457.
24. *Smith G. K.*: Early and accurate diagnosis of canine hip dysplasia. E.C.V.S. 11th Annual Scientific Meeting, Vienna 2002, 307-308.
25. *Smith G. K.*: New Paradigms for Hip Dysplasia Prevention and Control Performance and Ethics of CHD Screening as an indication for preventive Strategies. E.S.V.O.T. 12th Congress, Munich 2004, 125-131.
26. *Tomlinson J., Mc Laughlin R.*: Canine hip dysplasia: Developmental factors, clinical signs, and initial examination steps. Vet. Med. 1996, 91, 26-33.
27. *Vezzoni A.*: Is early evaluation reliable for CHD Diagnosis? E.S.V.O.T. 12th Congress, Munich 2004, 145-151.

Author's address: E. Guclu Gulanber, Ass. Prof., G&G Academia Animal Hospital, Menekseli sok. No.14, 1st Levent, 34330 Istanbul, Turkey; e-mail: gulanber@istanbul.edu.tr

PL ISSN 0025-8628

medycyna weterynaryjna

Veterinary Medicine – – Science & Practice



VOL. 62 LISTOPAD 2006 NOVEMBER NR 11

Medycyna Wet. 62 (11) 1209-1336 (2006)