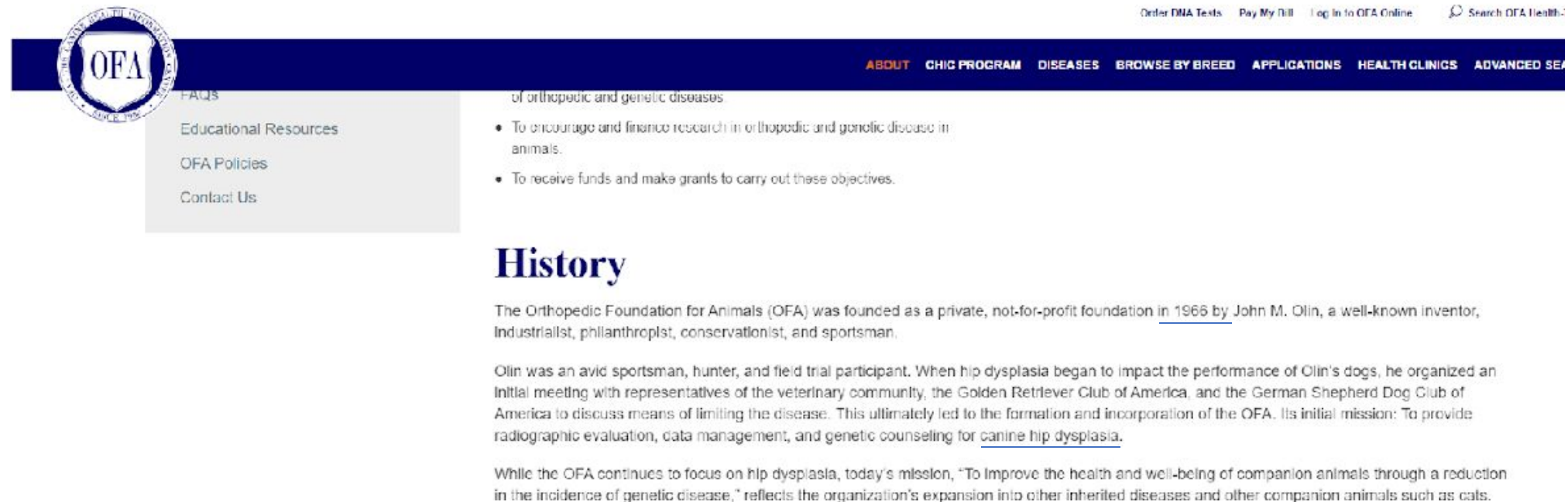


# Hip and elbow assessments

Prof. dr. Bart Broeckx


# Why?

- Hip and elbow dysplasia = matter of concern



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of orthopedic and genetic diseases.

- To encourage and finance research in orthopedic and genetic disease in animals.
- To receive funds and make grants to carry out these objectives.

## History

The Orthopedic Foundation for Animals (OFA) was founded as a private, not-for-profit foundation in 1966 by John M. Olin, a well-known inventor, industrialist, philanthropist, conservationist, and sportsman.

Olin was an avid sportsman, hunter, and field trial participant. When hip dysplasia began to impact the performance of Olin's dogs, he organized an initial meeting with representatives of the veterinary community, the Golden Retriever Club of America, and the German Shepherd Dog Club of America to discuss means of limiting the disease. This ultimately led to the formation and incorporation of the OFA. Its initial mission: To provide radiographic evaluation, data management, and genetic counseling for canine hip dysplasia.

While the OFA continues to focus on hip dysplasia, today's mission, "To improve the health and well-being of companion animals through a reduction in the incidence of genetic disease," reflects the organization's expansion into other inherited diseases and other companion animals such as cats.

# Why?

- Hip and elbow dysplasia = matter of concern
- 1966: foundation OFA
- Assistance dogs:
  - $\pm$  18% rejections due to orthopedic disorders
    - $\pm$  90% due to hip and/or elbow dysplasia

=> How to tackle these problems?

Towards a solution

# Towards a solution

Main goal:

Avoid rejections due to hip and/or elbow dysplasia

Practically,

- If no access to breeding program:

Select dogs good enough to work

What is maximally achievable: no progress, each time starts anew

- If access to breeding program:

Select “good” dogs, breed them

What is maximally achievable: eradicate problem

# Towards a solution

Not part of this presentation:

- Speeding up process by using EBVs or genomic selection

Part of this presentation:

- Speeding up process by optimal diagnostical techniques

⇒ Combination = best results

Hip dysplasia

# Definition

- What is canine hip dysplasia? (CHD)
  1. literally: an abnormal (dys) development (plassein) of the hip
  2. *“Varying degree of **laxity** of the hip joint permitting subluxation during early life, giving rise to varying degrees of shallow acetabulum and flattening of the femoral head, and finally inevitably leading to **osteoarthritis**”*

Etiology/pathogenesis

# Etiology/pathogenesis

- Laxity

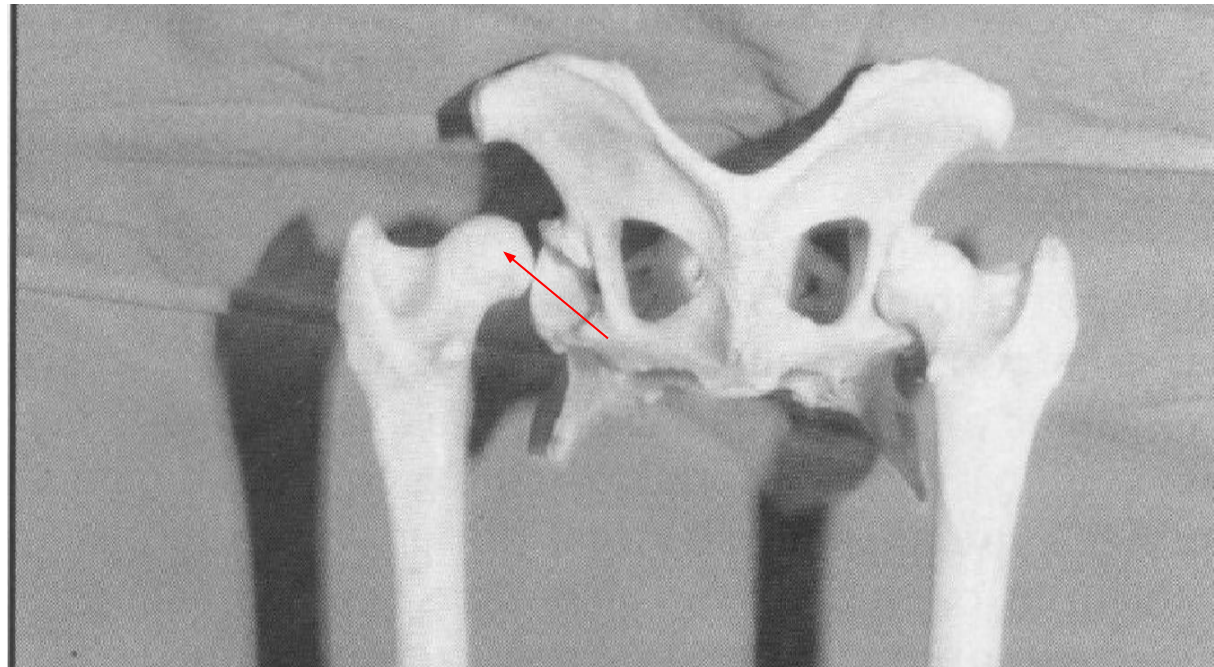
*“the amount of movement of the femoral head in the acetabulum”*



# Etiology/pathogenesis

- Laxity

*“the amount of movement of the femoral head in the acetabulum”*



# Etiology/pathogenesis

- Laxity

*“the amount of movement of the femoral head in the acetabulum”*

- (Delayed ossification)

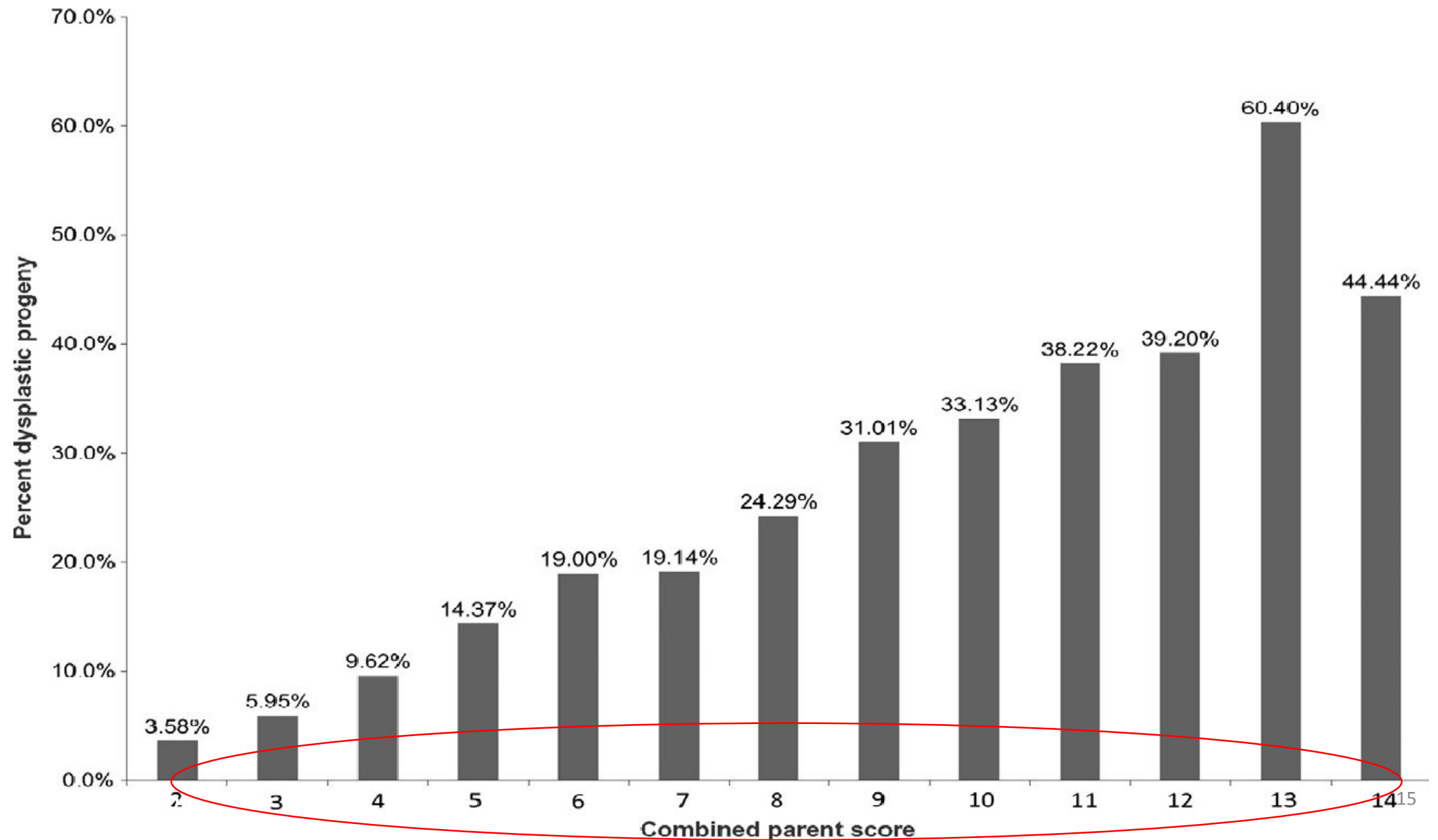
=> Leads to secondary changes = arthrosis

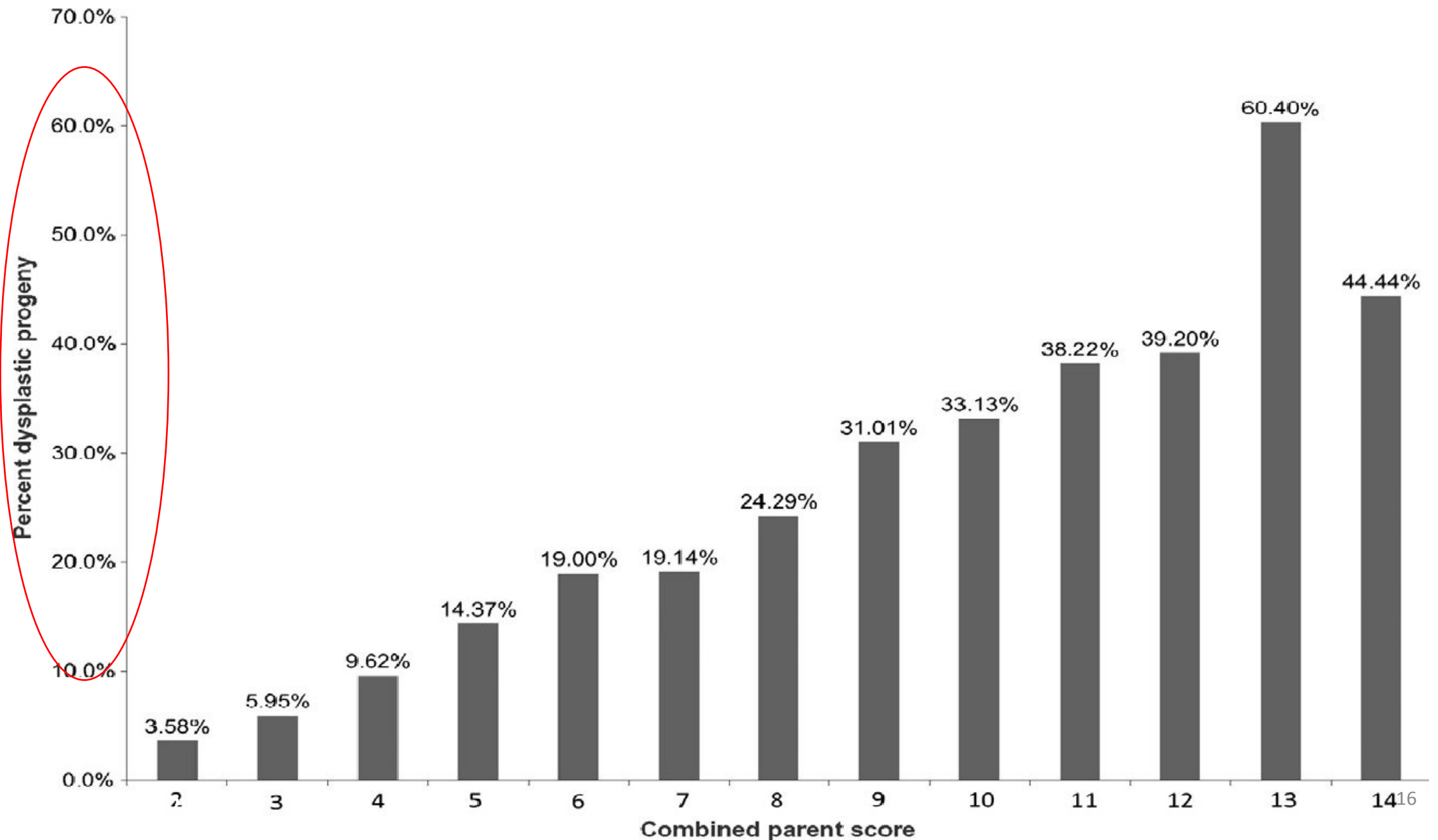
# Diagnosis/Screening

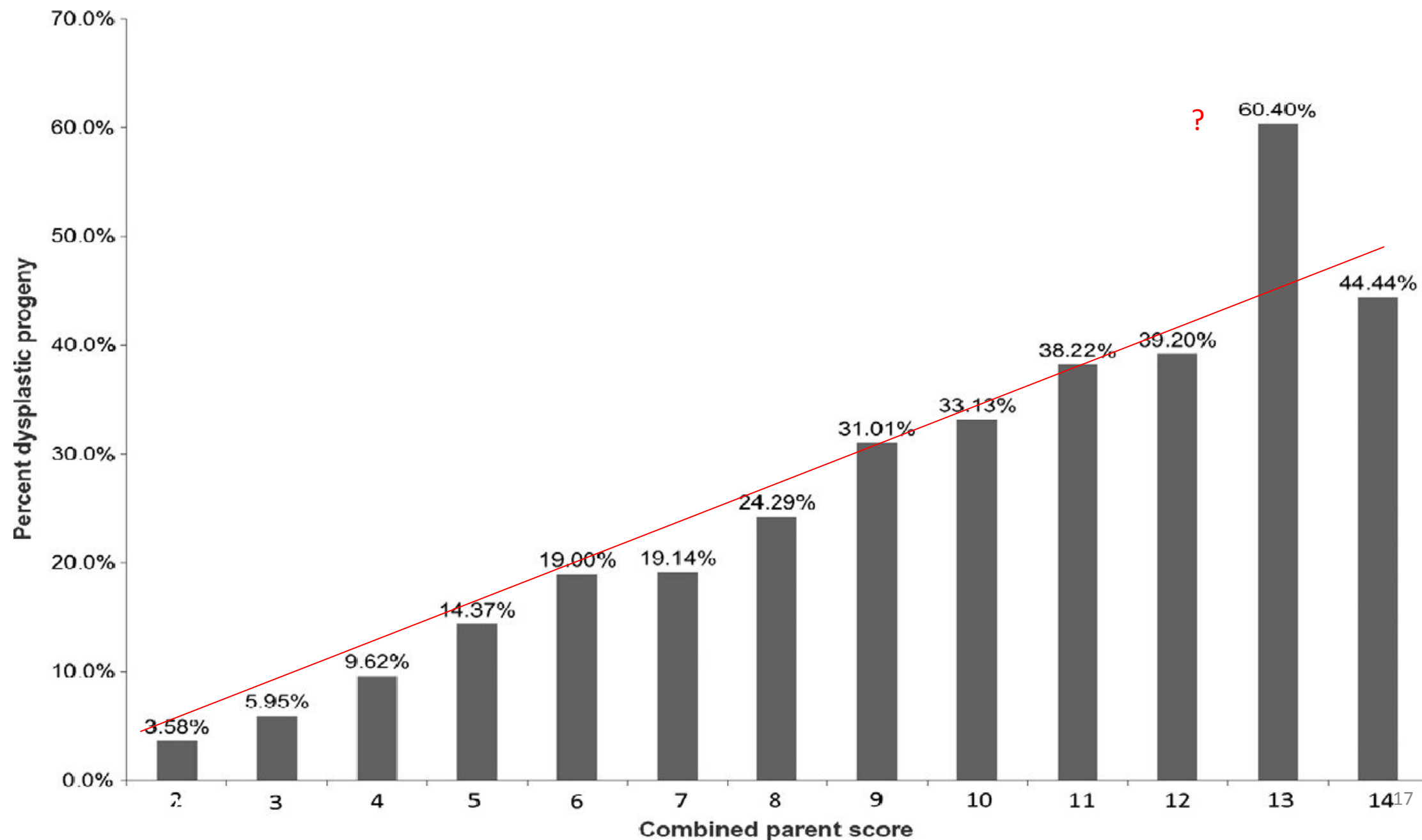
- Standard ventrodorsal hip extended radiograph

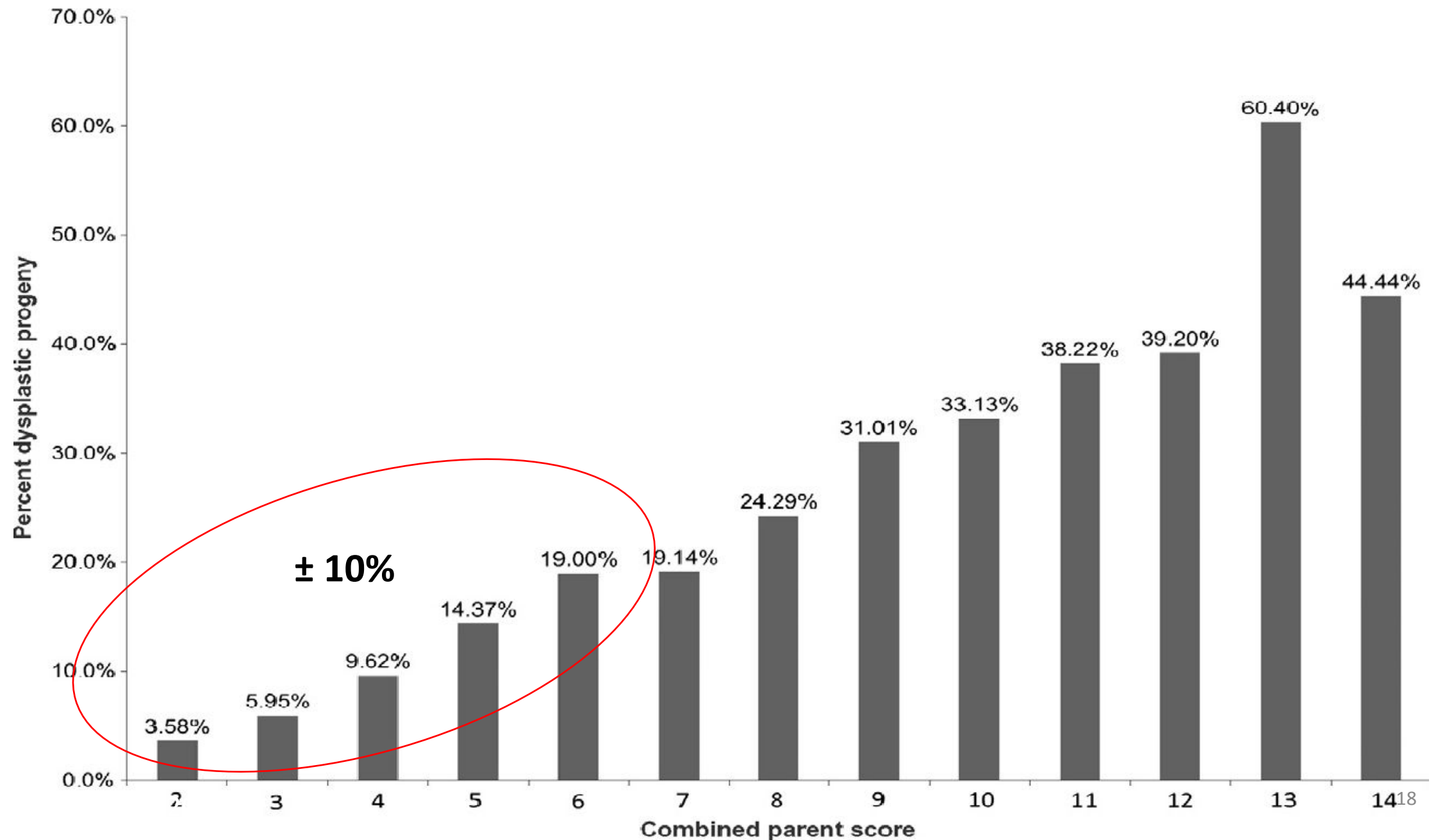


How far did the general population get?



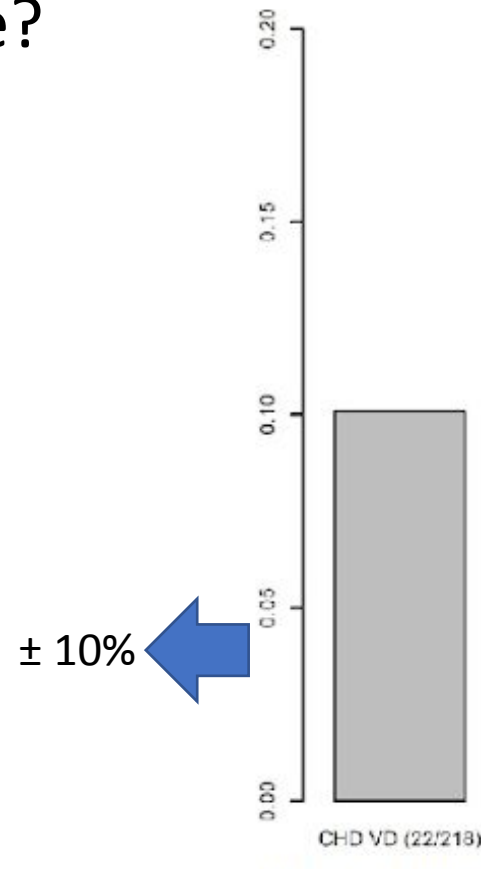






# How far did the general population get?

- Dogs with passing grades => affected progeny?
- Situation in Europe?

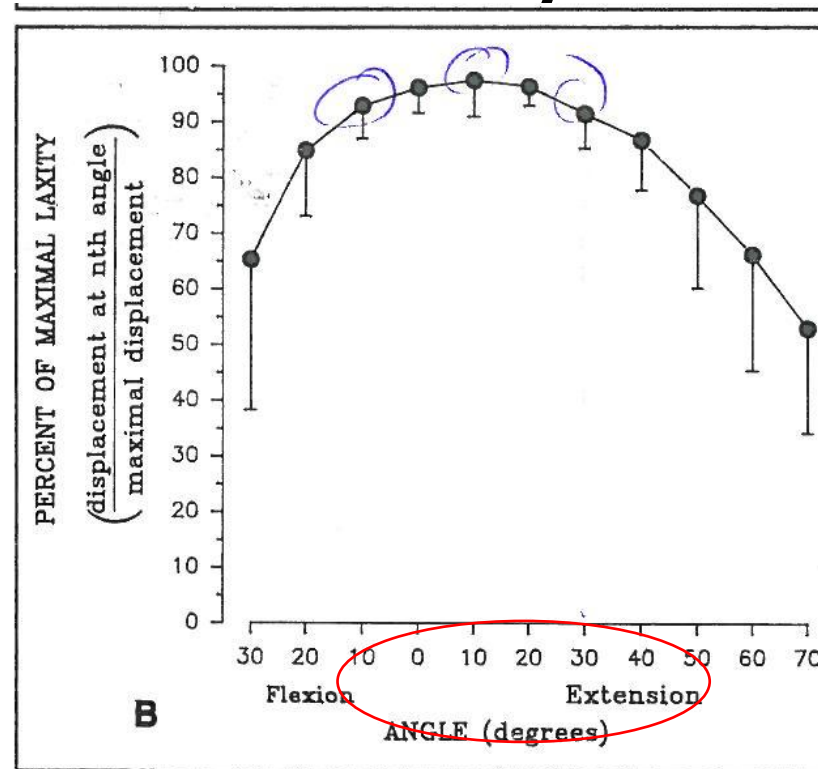


What are we missing?

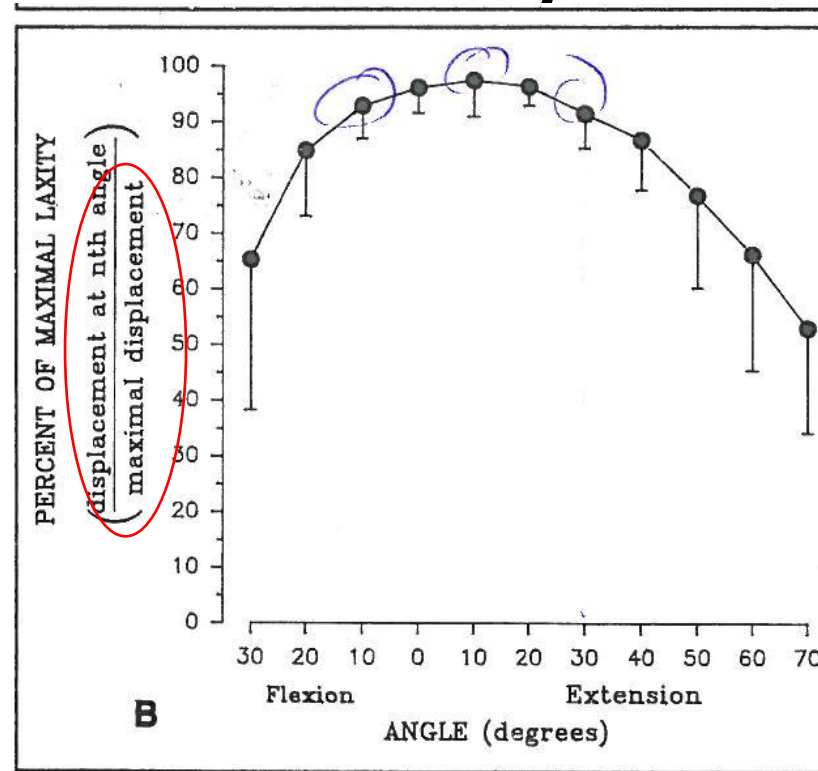
# Diagnostics: Problems

- Standard ventrodorsal hip-extended radiograph
  - Laxity

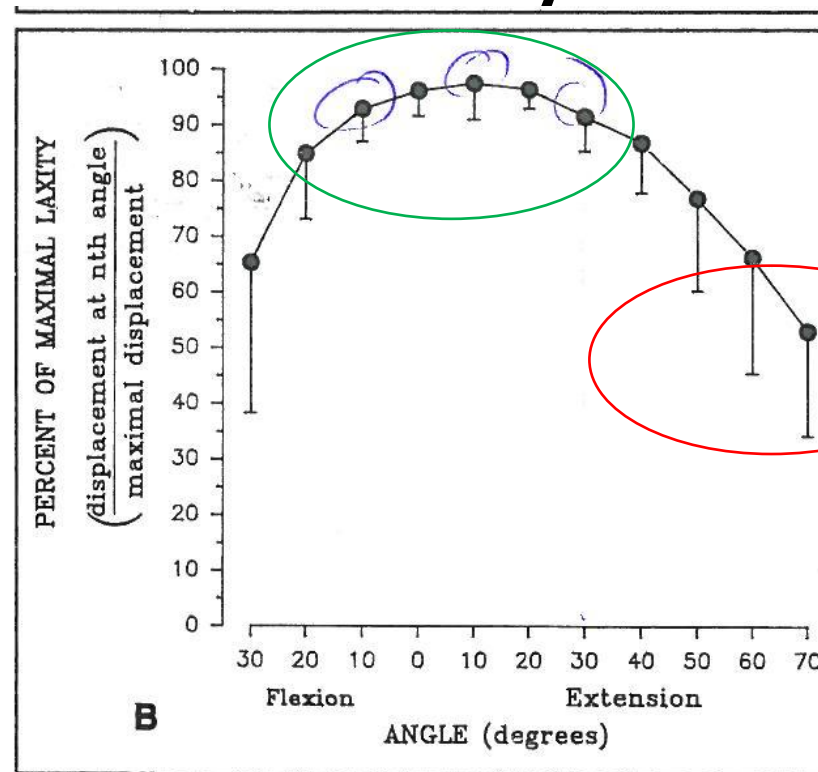
# Laxity



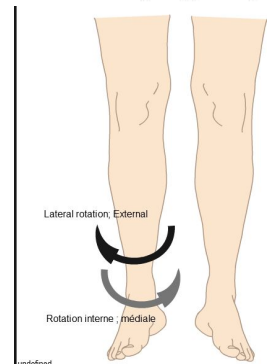
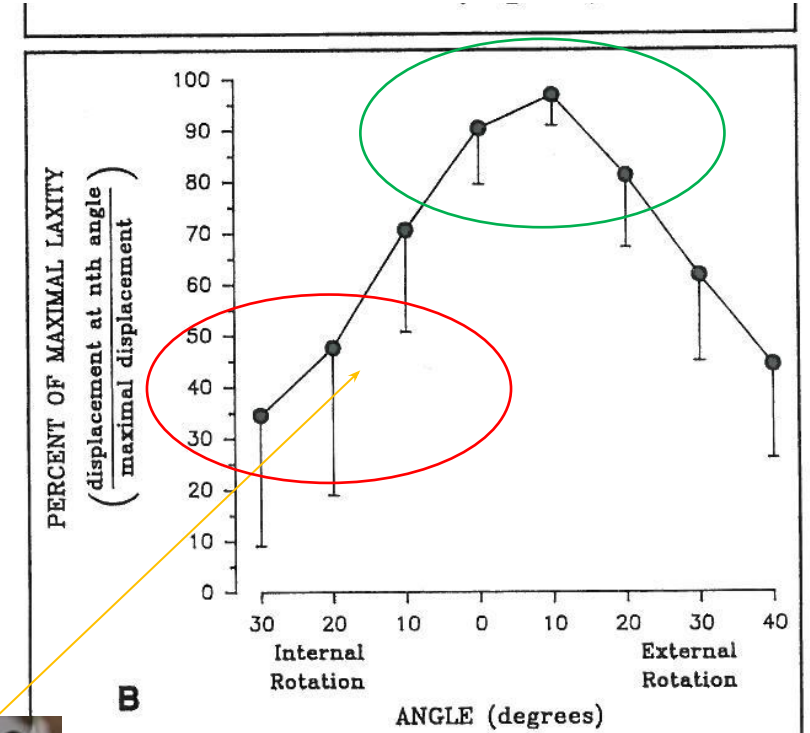
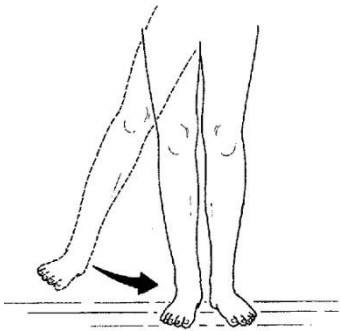
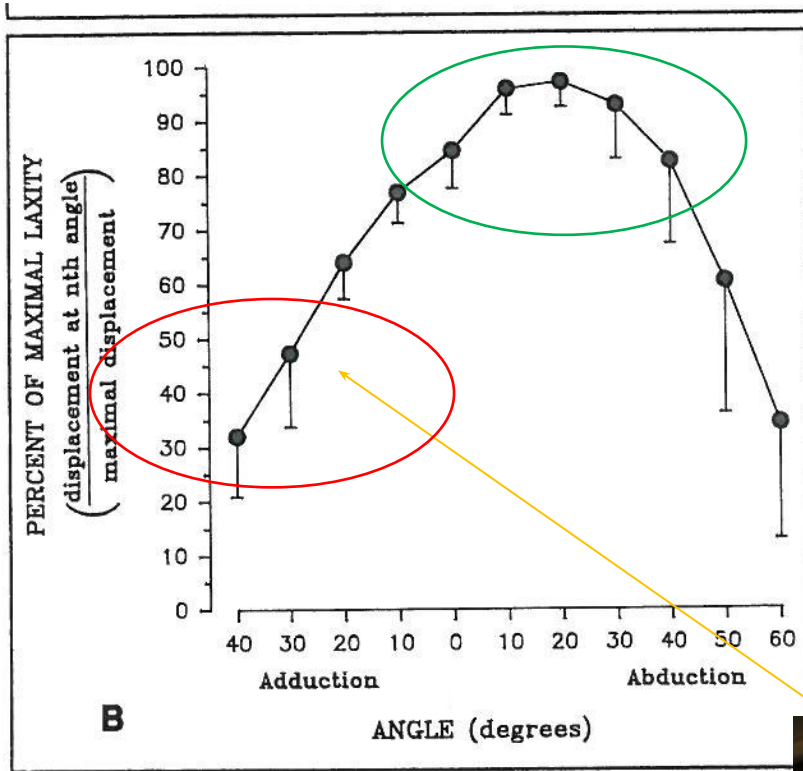
# Laxity



# Laxity

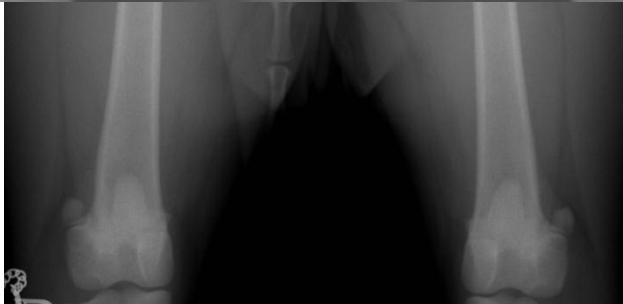


# Laxity



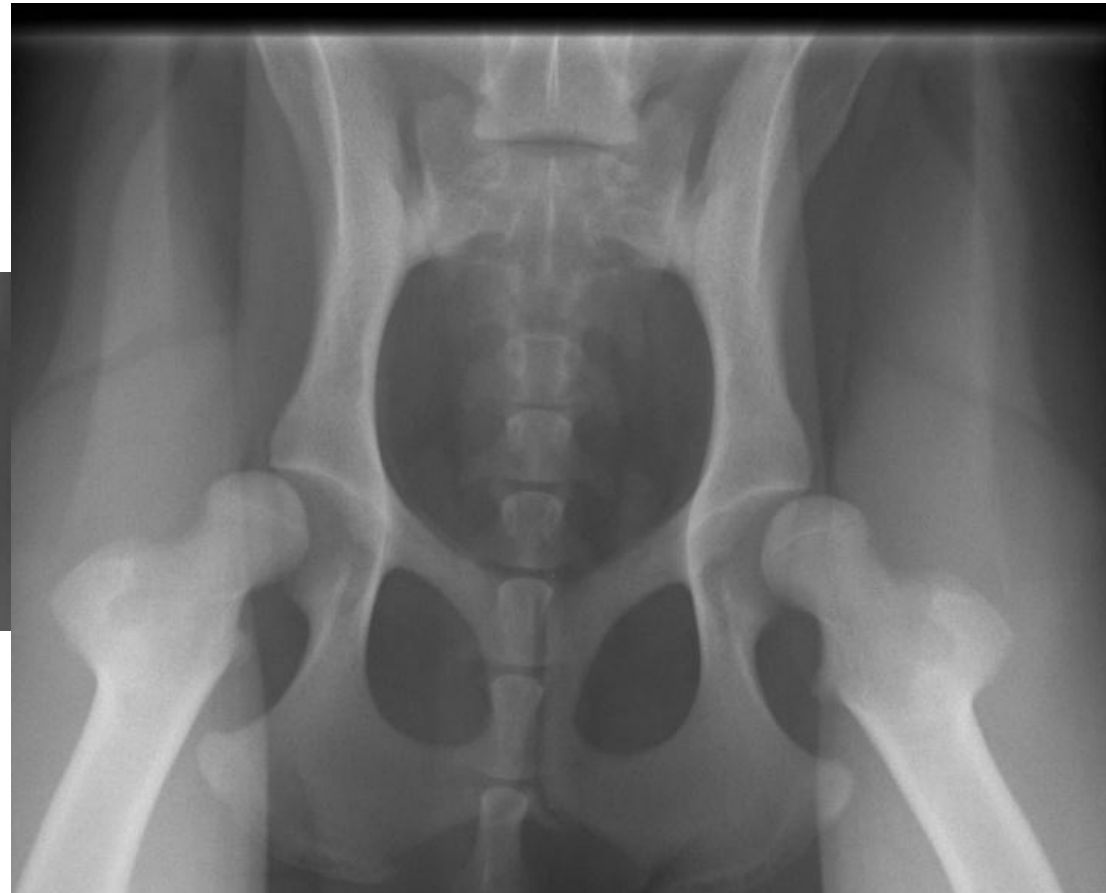
# Laxity

An example:



# Laxity

An example:



# Diagnostics: Problems

- Standard ventrodorsal hip-extended radiograph
  - Laxity
  - Age

# Diagnostics: Problems

- Standard ventrodorsal hip-extended radiograph
  - Laxity
  - Age
  - Sedation/anesthesia
  - Interobserver agreement

# Interobserver agreement

An example:



HD +	HD -
5	5

# Diagnostics: Problems

- Standard ventrodorsal hip-extended radiograph
  - Laxity (cause of clinical symptoms of “healthy” dogs on VD!)
  - Age
  - Sedation/anesthesia
  - Interobserver agreement

=> Problem!!

# Is there a solution?

YES

Specific techniques that can be used to diagnose laxity

# Laxity techniques

Combination of

- Standard radiograph
- Vezzoni modified Badertscher distension device (VMBDD) technique

OR

Combination of

- Standard radiograph
- Distraction radiograph
- Compression radiograph

# Vezzoni



Standard VD



Distension view

Distraction view



Compression



Standard VD



PennHIP

# Laxity techniques

Combination of

- Standard radiograph

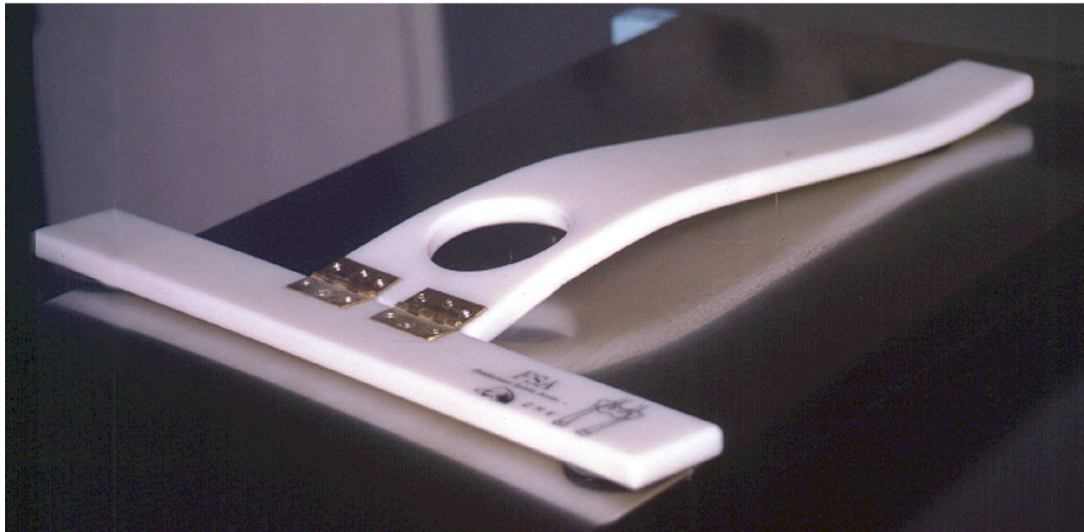
⇒ evaluation osteoarthritis

- Distension view (Vezzoni)/ Distraction view (PennHIP)

⇒ evaluation laxity

# Laxity techniques

Vezzoni technique



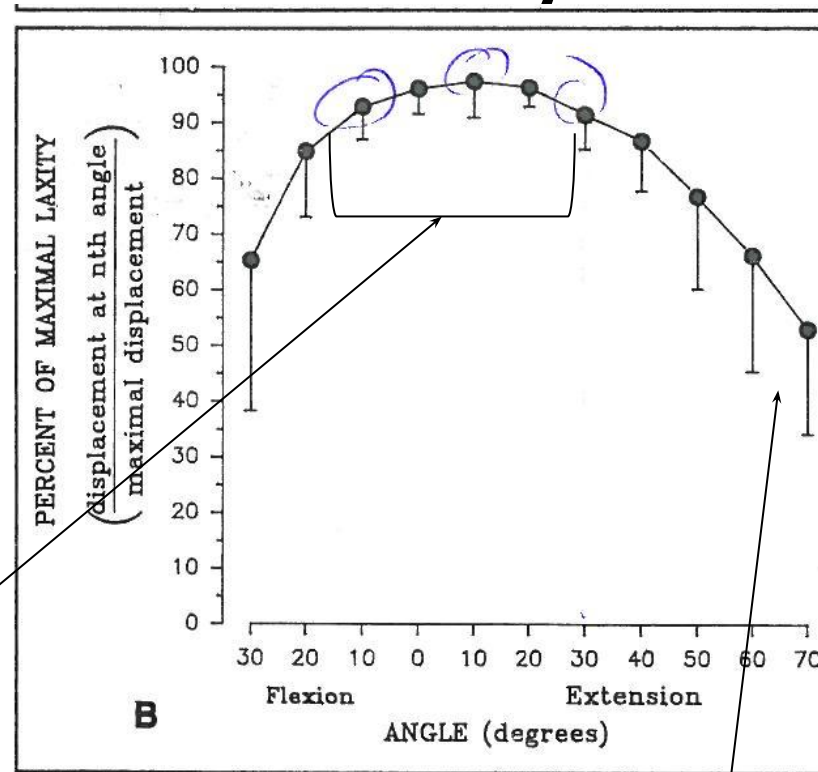
PennHIP



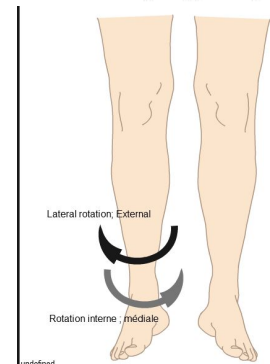
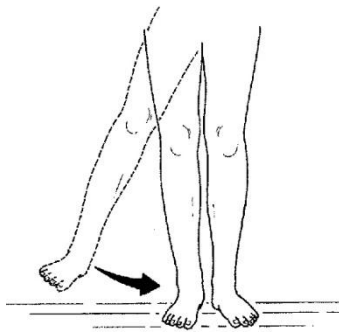
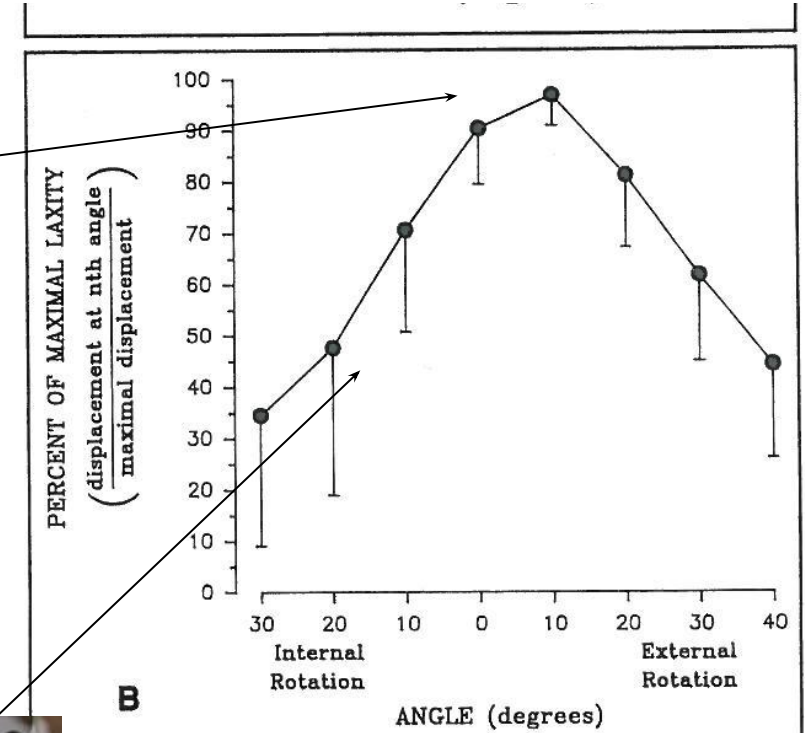
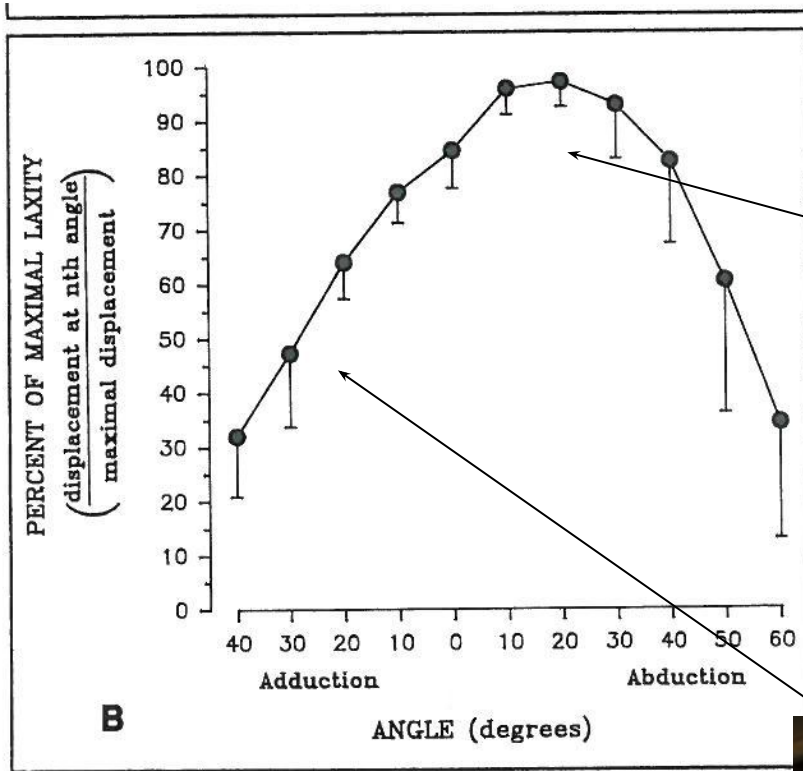
# Diagnose

- Why is this technique a solution
- Problems standard technique  
⇒ Laxity
- Laxity techniques  
Designed to detect laxity

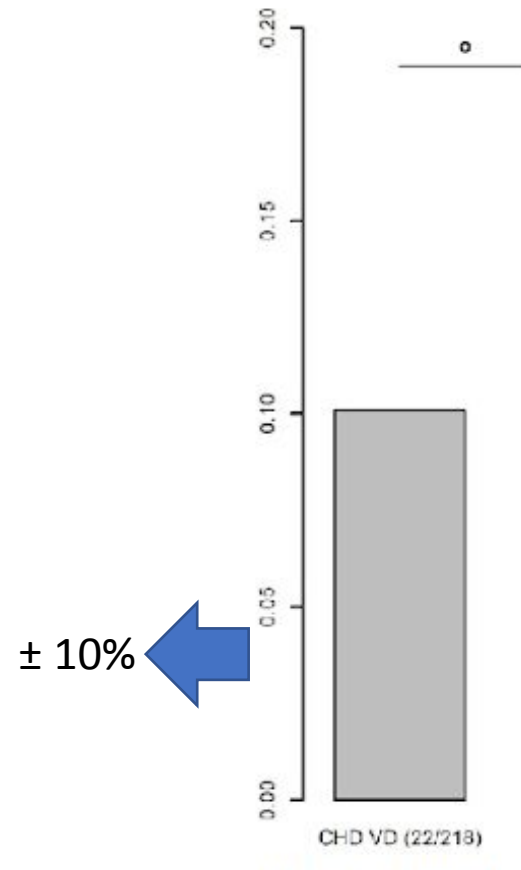
# Laxity



# Laxity



# How much do we potentially miss with VD?



# Diagnose

- Why is this technique a solution

• Problems standard technique	Laxity techniques
⇒ Laxity	Designed to detect laxity
⇒ Age	Primary cause of HD detected
⇒ Sedation/anesthesia	Always sedated
⇒ Interobserver agreement	Good agreement

# Quantifying laxity

- Vezzoni: the laxity index
- PennHIP: the distraction index
- Values: 0.0 – >1.0

# How do we use them?

- Distinguish:
  - Dogs with scores good enough to work
  - Dogs with scores good enough for breeding => strictest
- Our criteria:
  - Dogs **not suitable for either**: hip dysplasia VD **OR** laxity index of >0.7
  - Dogs **suitable as an assistance dog**: passing grade VD **AND** laxity-index < 0.7
  - Dogs **suitable for breeding**: passing grade VD **AND** dogs in the best part of the laxity-index (**THAT ALSO MEET SUFFICIENTLY THE OTHER CRITERIA**).

# Does this work?

- Added value of laxity views?

Proportion of puppies with hip dysplasia:

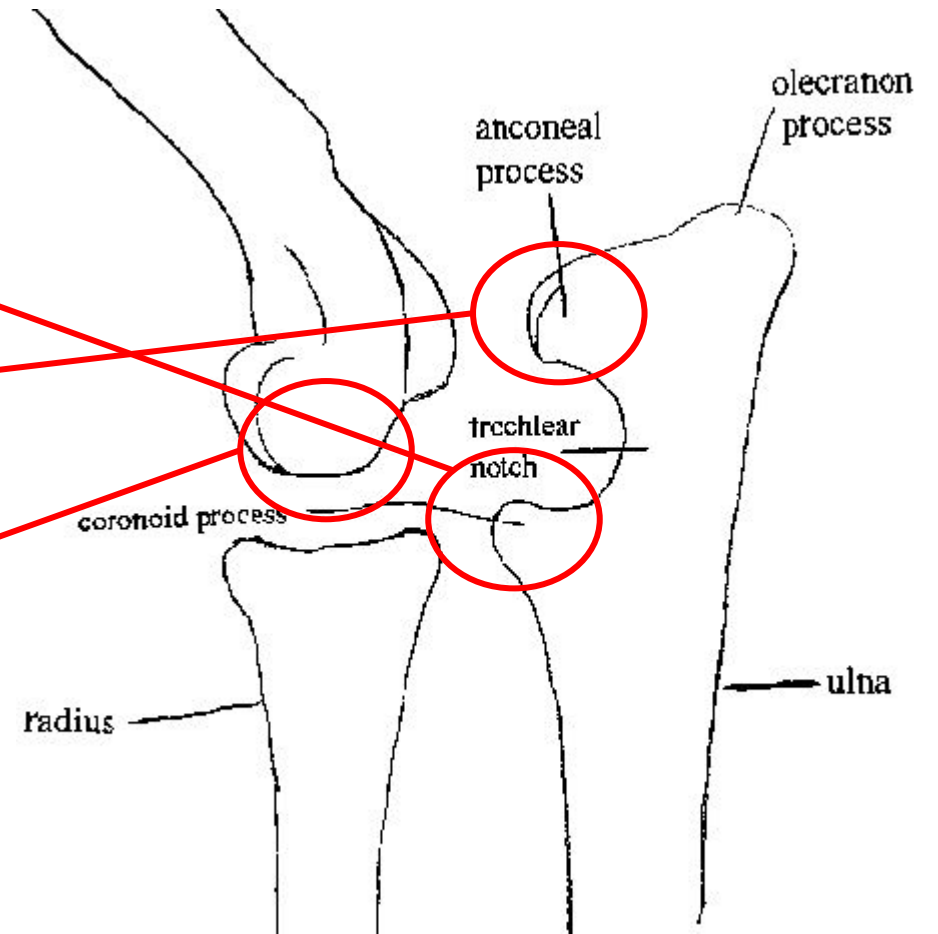
- parents checked VD x VD: 23.0%
- parents checked VD+L x VD: 7.5%
- parents checked VD+L x VD+L: 1.6%

Elbow dysplasia

# Elbow dysplasia: definition

## Primary problems

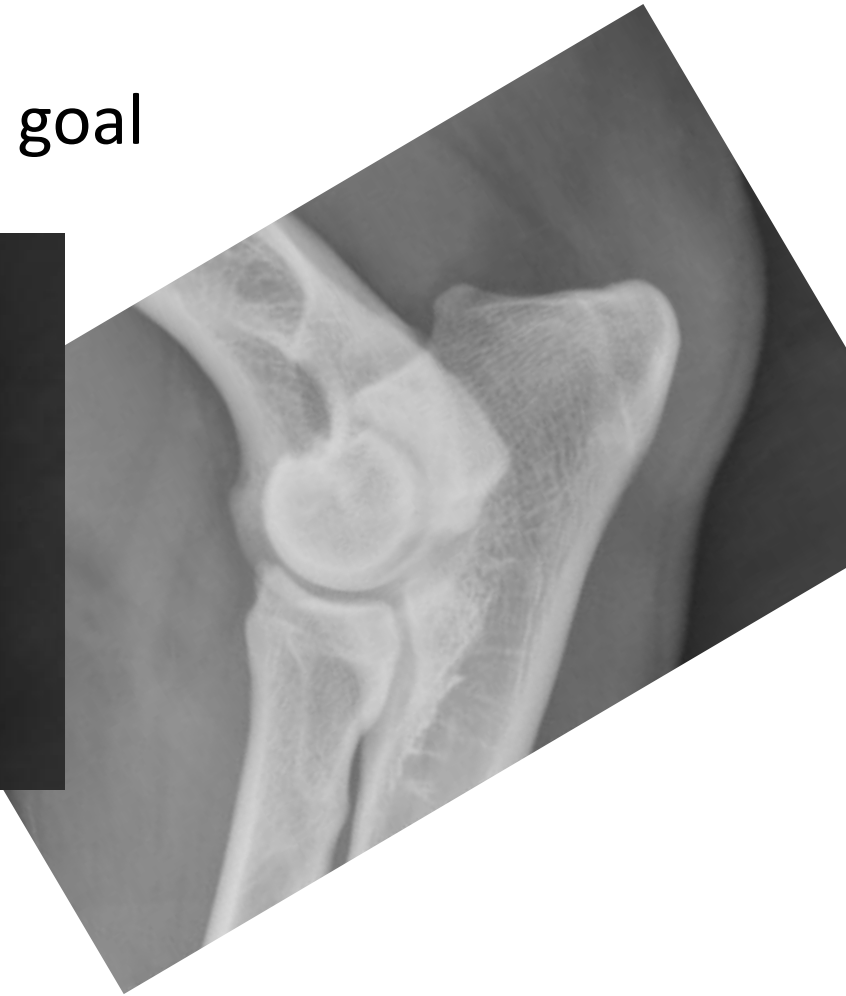
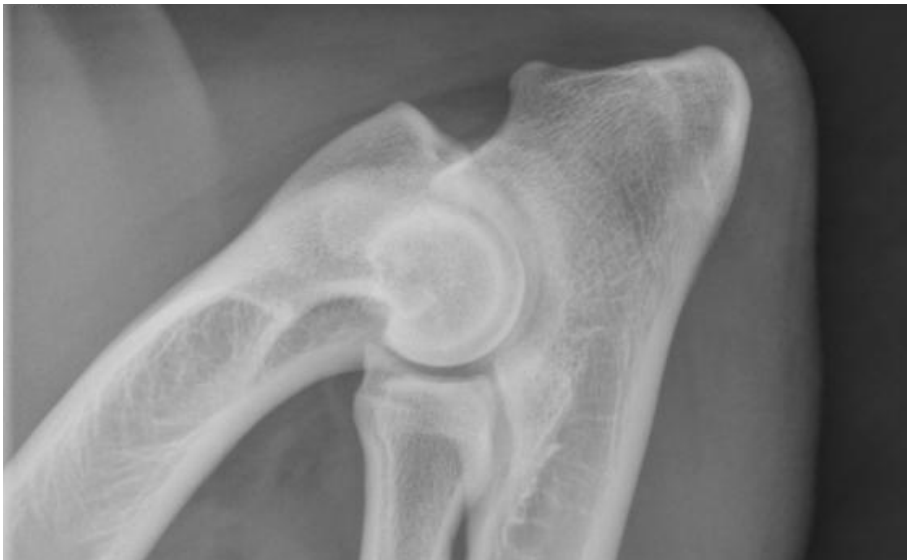
- Fragmented Medial coronoid process (FMCP)
- Ununited Anconeal Process (UAP)
- Osteochondrosis/Osteochondritis dissecans (OCD)
- Incongruity



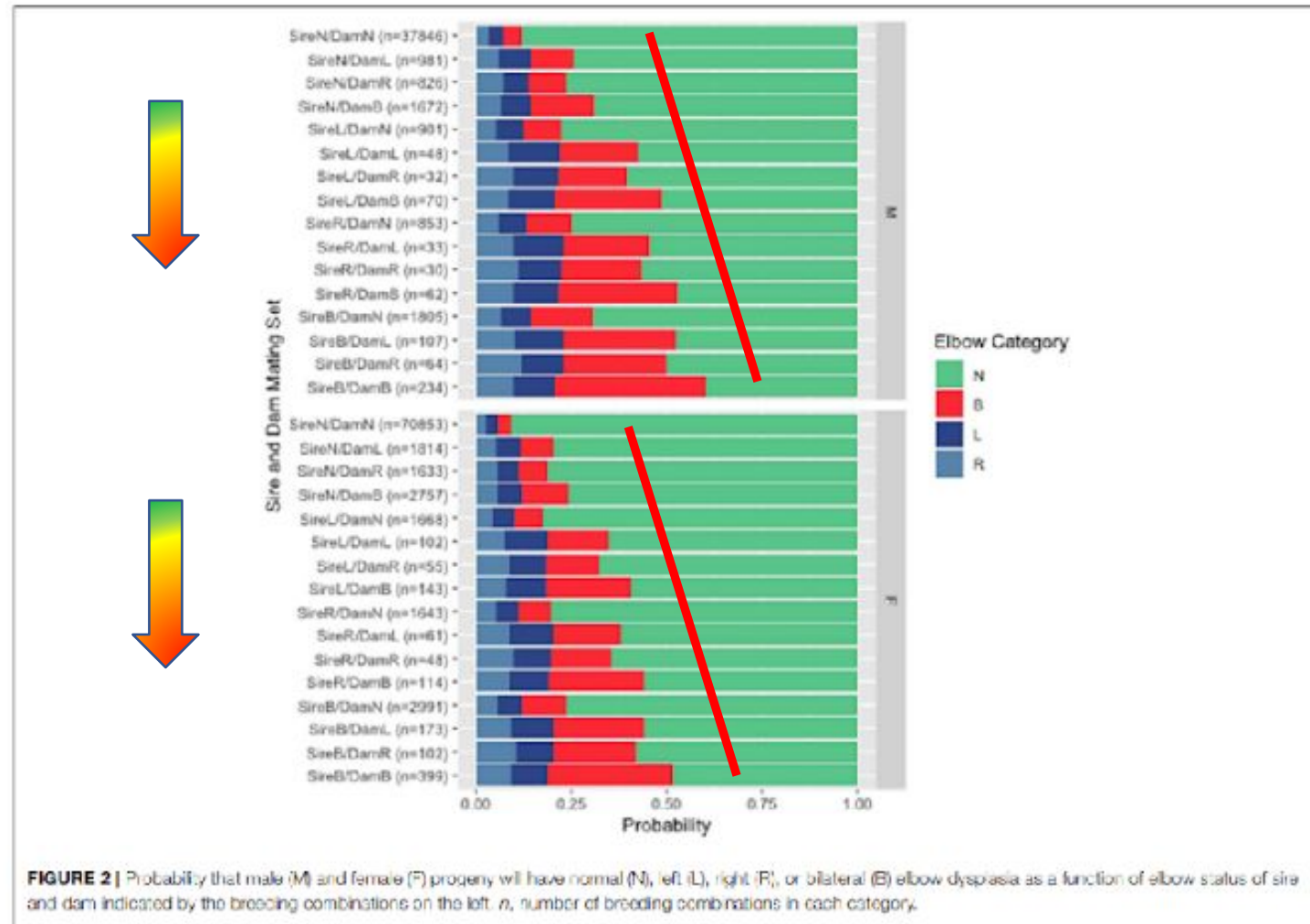
## Secondary osteoarthritis

# Diagnosis/Screening

Each radiograph => specific goal



# Observations from the general population

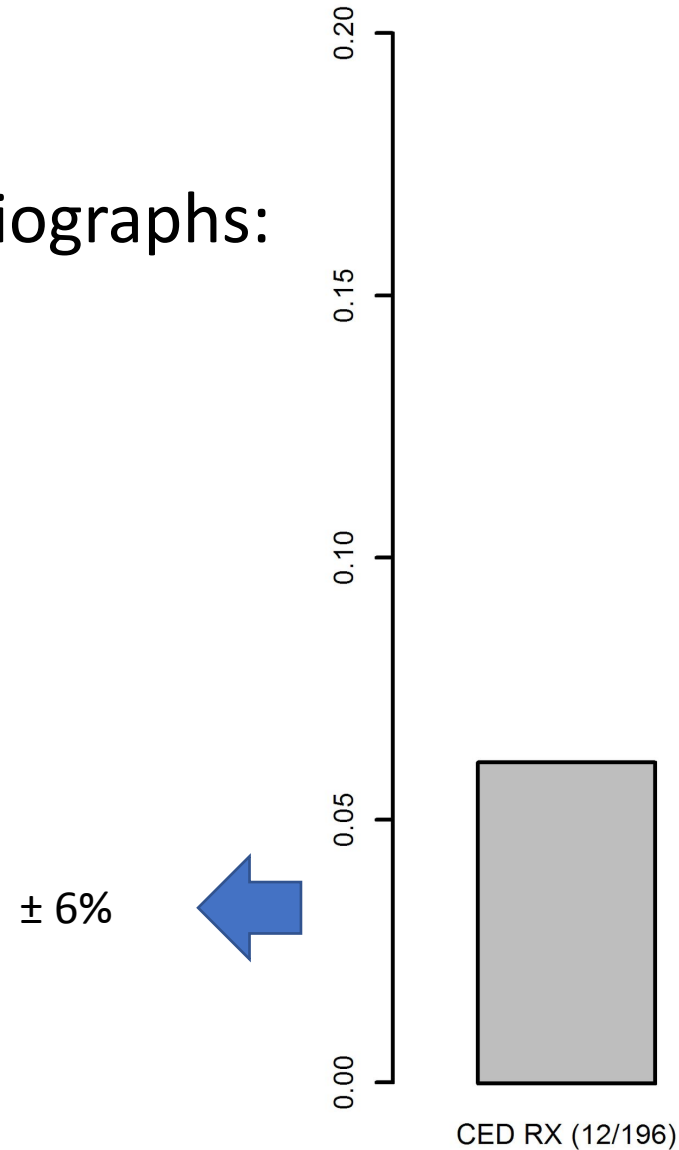


**TABLE 3 |** Prevalence, by breed

Breed	Normal x normal	
ACD	0.071	
AS	0.026	
BF	0.082	
BMD	0.164	
BMF	0.179	
CC	0.174	
FS	0.111	
EN	0.113	
GR	0.072	
GS	0.127	
LR	0.083	
MF	0.106	
NF	0.198	
RO	0.252	
RR	0.050	
SMD	0.067	

# Elbow dysplasia prevalence

Based on three radiographs:



What are we missing?

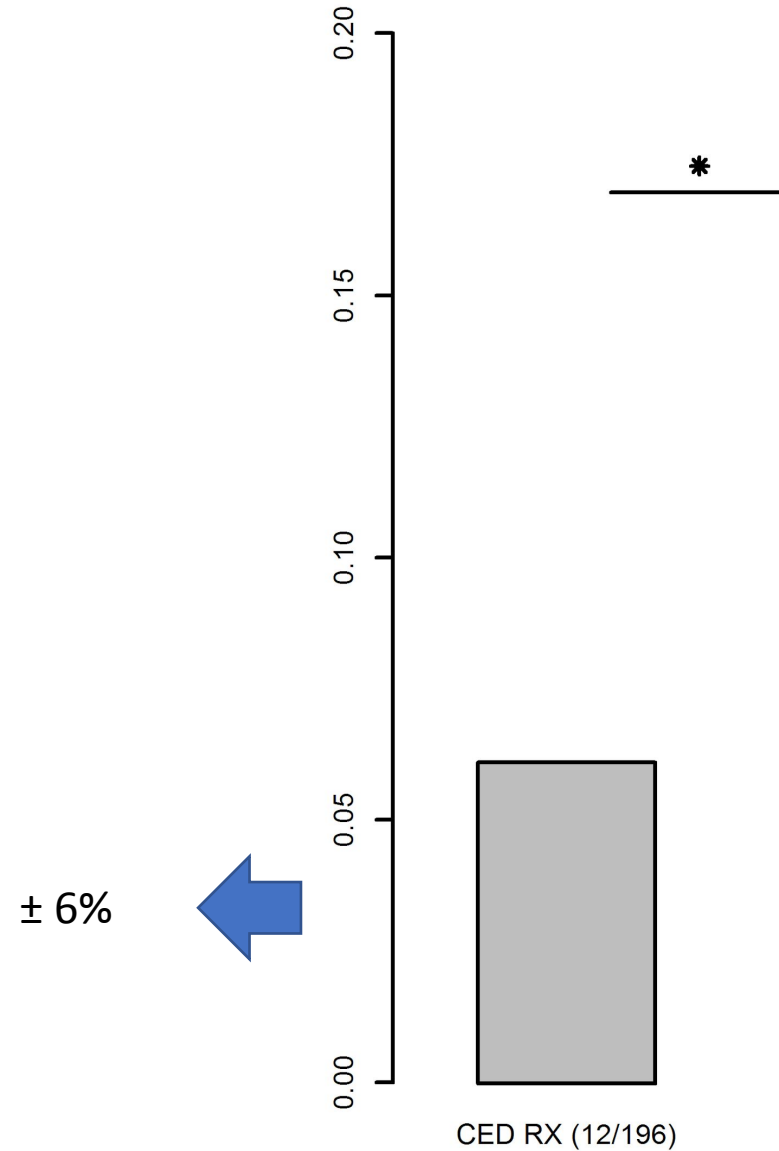
# What are we missing?

- If  $< 3$  radiographs are used:  
⇒ The lesion visible on the one left out
- If 3 or more radiographs are used?

# CAT-scan



# Elbow dysplasia prevalence



# Cause of incorrect diagnosis

- Radiographs: 2D projection of 3D structure
- A lot of superposition
- More detailed images with CT (e.g. non-displaced fragment)

# How do we use them?

- Distinguish:
  - Dogs with scores good enough to work
  - Dogs with scores good enough for breeding => strictest
- Our criteria:
  - Dogs **not suitable for either**: elbow dysplasia degree
  - Dogs **suitable as an assistance dog**: passing grade
  - Dogs **suitable for breeding**: passing grade

# Does this work?

- Added value of CAT-scans?

Proportion of puppies with elbow dysplasia:

- parents checked RX x RX: 21.3%
- parents checked CAT-scan x RX: 13.3%
- parents checked CAT-scan x CAT-scan: 9.3%

⇒ Further improvements?

- Time
- EBVs
- Better knowledge of subtle lesion consequences

# What about subtle lesions?

## International elbow working group

Elbow Dysplasia Scoring		Radiographic Findings
0	Normal elbow joint	Normal elbow joint, No evidence of incongruity, sclerosis or arthrosis
1	Mild arthrosis	Presence of osteophytes < 2 mm, <del>sclerosis of the base of the coronoid processes - trabecular pattern still visible</del> <del>Step - / &gt; 2 mm between radius and ulna</del>
2	Moderate arthrosis or suspect primary lesion	Presence of osteophytes 2 - 5 mm <del>Obvious sclerosis (no trabecular pattern) of the base of the coronoid processes</del> <del>Step of 3-5 mm between radius and ulna (INCONGRUITY)</del> <del>Indirect signs for other primary lesion (UAP, FCP/Coronoid disease, OCD)</del>
3	Severe arthrosis or evident primary lesion	Presence of osteophytes > 5 mm <del>Step of &gt; 5 mm between radius and ulna (obvious INCONGRUITY)</del> Obvious presence of a primary lesion (UAP, FCP, OCD)

Pure incongruency?  
Sclerosis?

# Conclusion

# Conclusion

- “Old techniques”: incorrect classification
  - Optimal diagnostical technique => marked improvements!
  - Key = standardized evaluations! (same person(s), same criteria, same ...)
- ⇒ e.g. PennHIP: central evaluation USA
- ⇒ e.g. Vezzoni and CAT-scans: voluntary central evaluation Ghent University together with Purpose Dogs

# Conclusion

When to include? => Cost-benefit analysis positive

- One dog rejected at screening age: average cost  $\pm$  4.109 euro

=> One dog rejected **less**: saved  $\pm$  4.109 euro

- Thanks to these techniques: +/- 20% less rejections

=> Total sum (based on population size at study time):

52.471 euro **saved**

=> Screening costs hip and elbow dysplasia for >200 dogs! (or  $\pm$  3 times the entire population of Purpose Dogs at that time)

# Conclusion

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52.471 euro **saved**

⇒ Screening costs hip and elbow dysplasia for >200 dogs! (or  $\pm$  3 times the entire population of Purpose Dogs at that time) ✓

# Conclusion

- Exact cut-offs: take population-specific characteristics into account
- Take the whole dog into account!

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Ghent University



@ugent



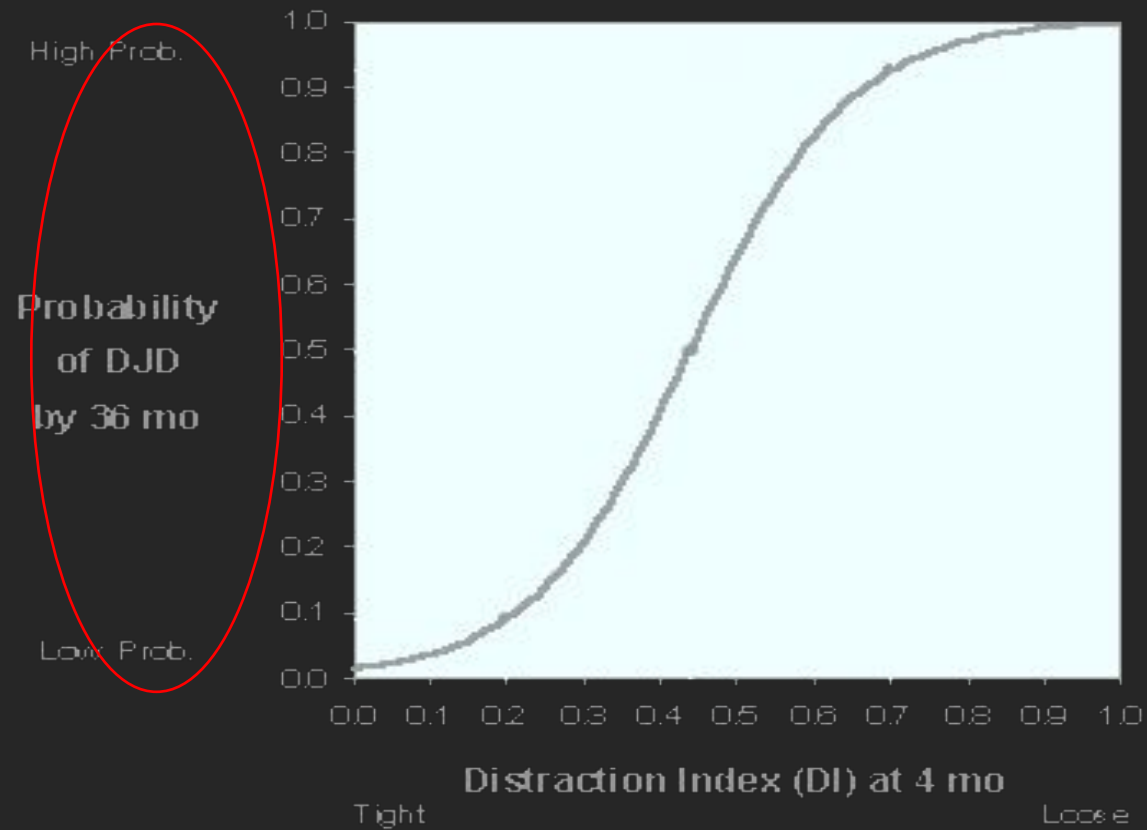
Ghent University



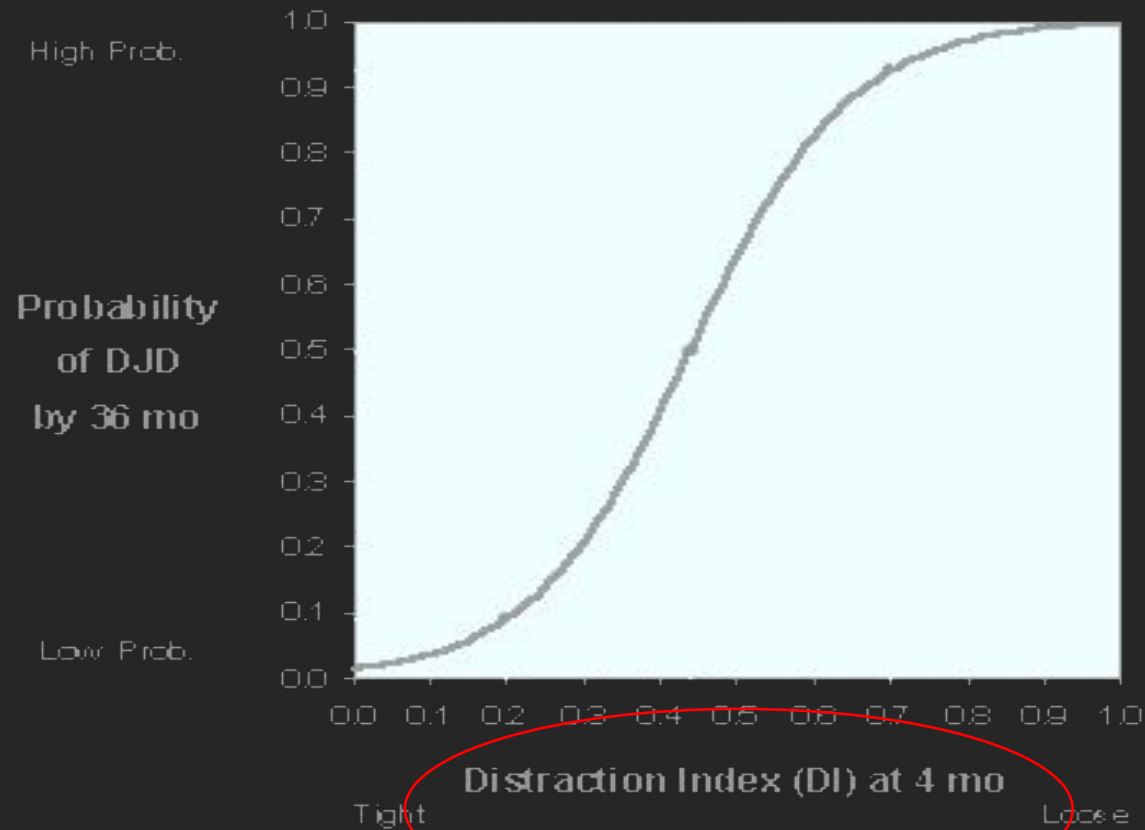




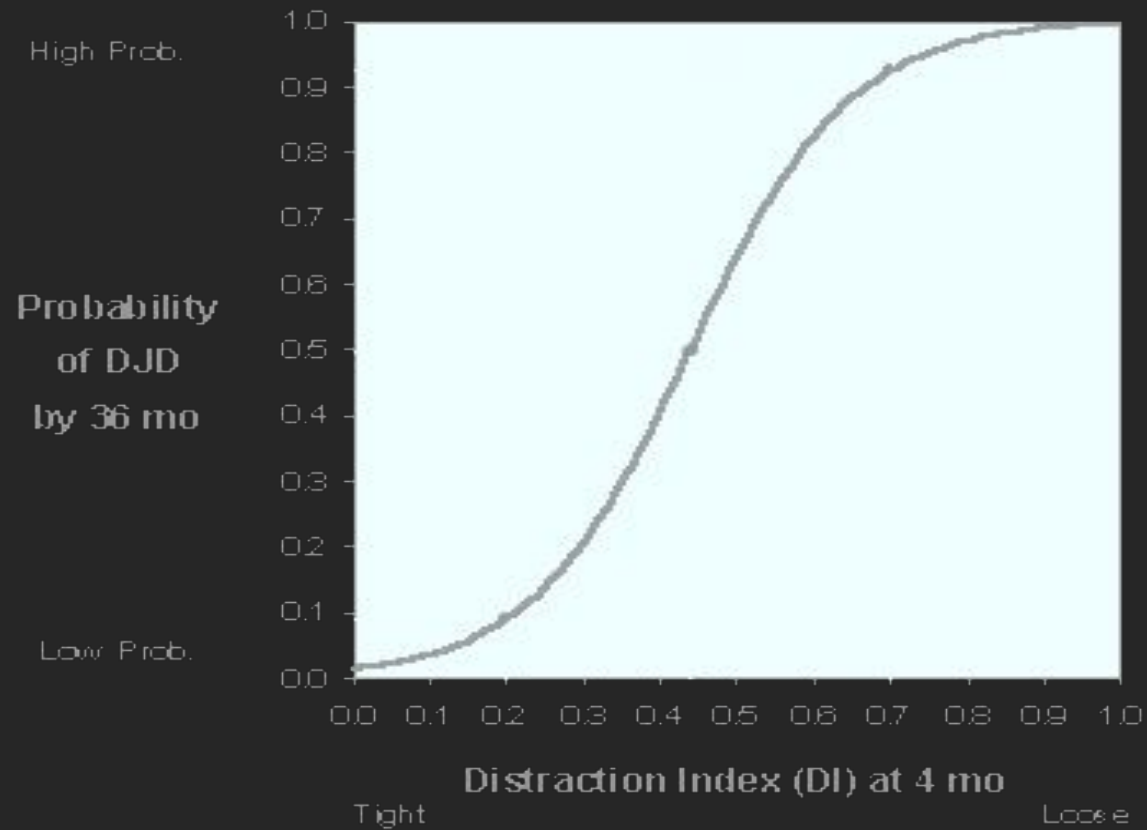
# Diagnosis



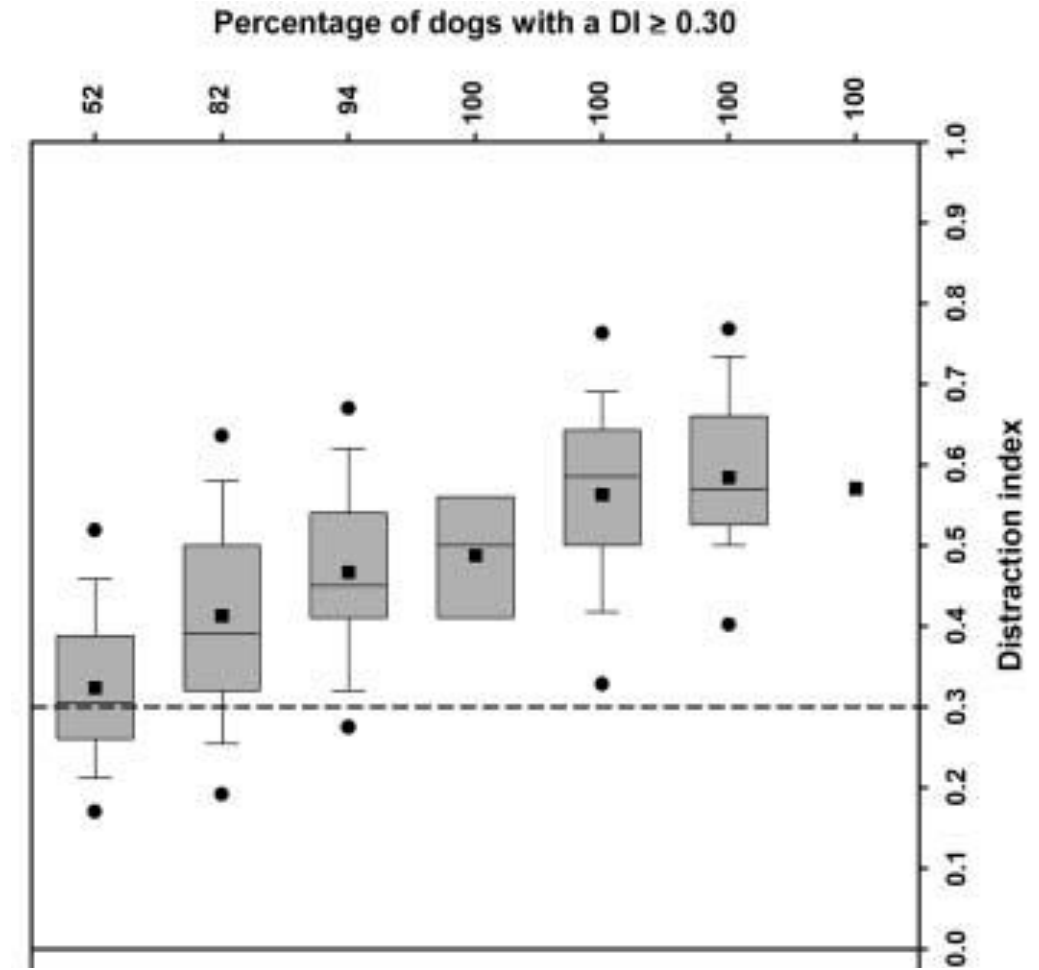
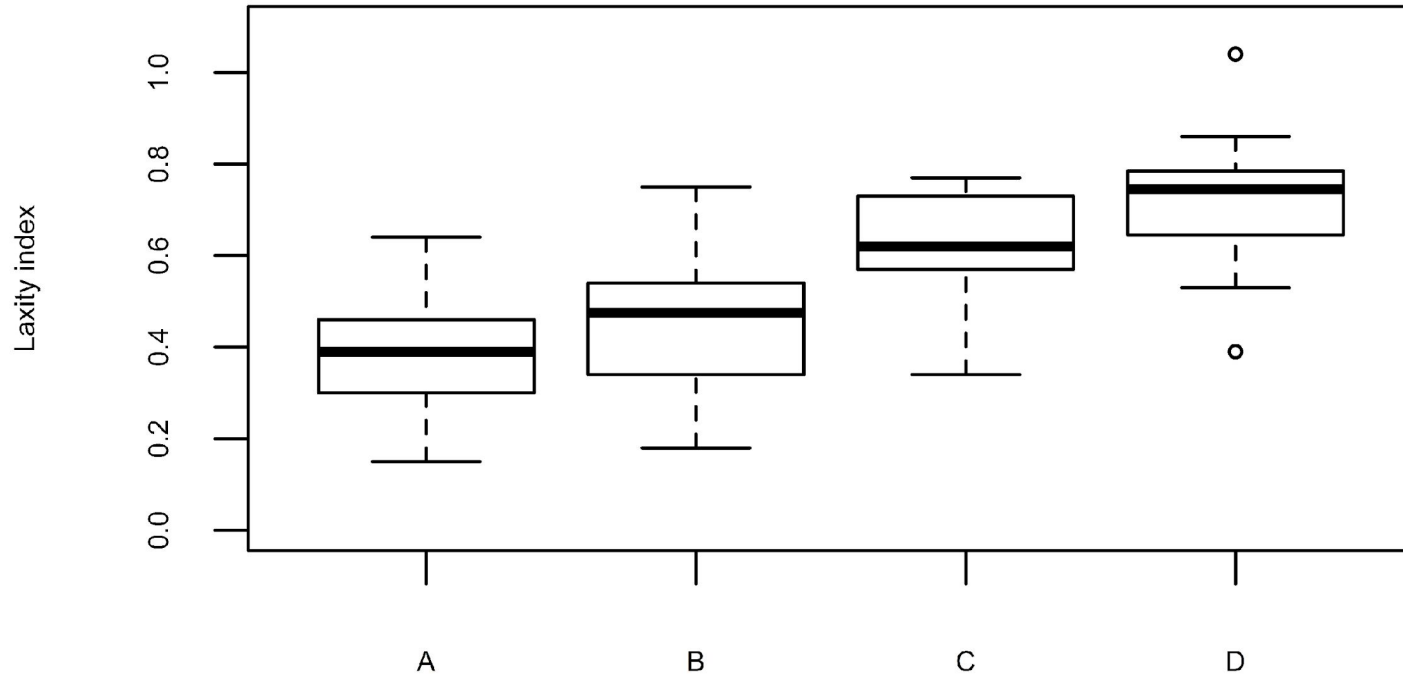
# Diagnosis



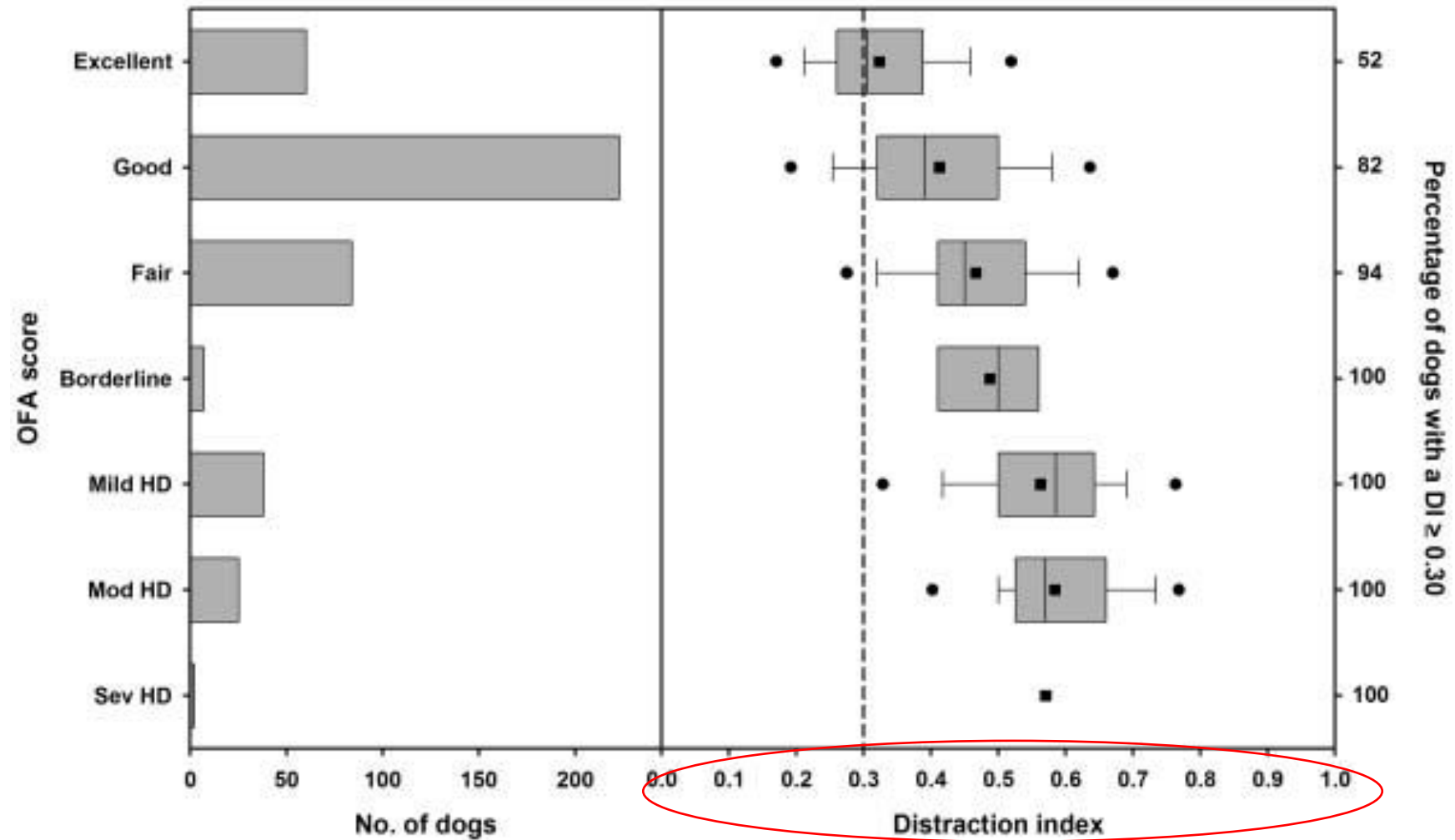
# Diagnosis



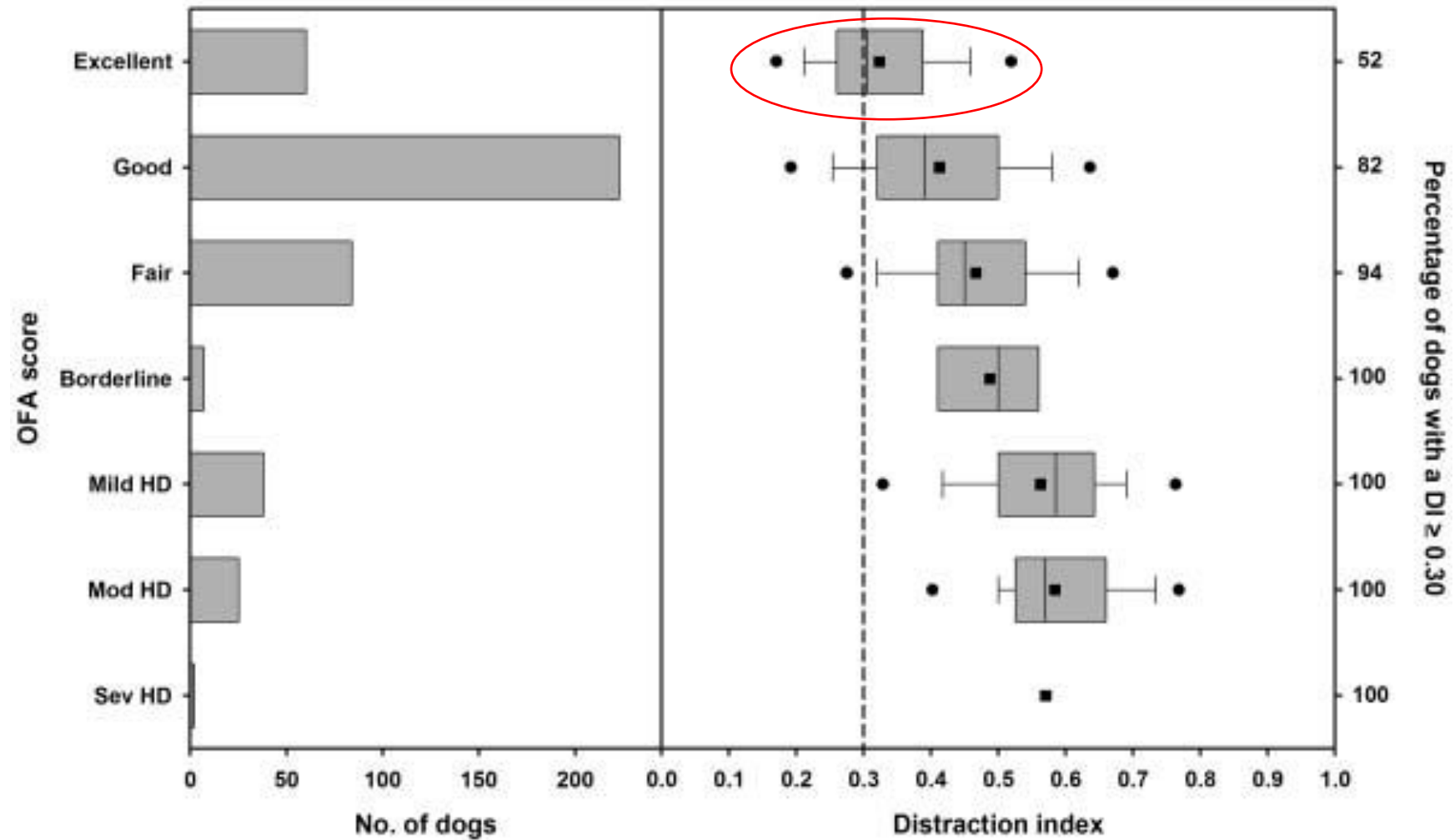
# Laxity



# Laxity



# Laxity



# Diagnostics

## Solution

⇒ Laxity based techniques:

	PennHIP	Vezzoni
Age	> 4 months (6 months)	?
Evaluation of laxity + DJD	✓	✓
Obligatory sedation	✓	✓
High reproducibility	✓	✓

	PennHIP	Vezzoni
Number of radiographs	3	2
Central evaluation?	Obligatory (USA)	Voluntary (Ghent University together with Purpose Dogs)

# Does this work?

