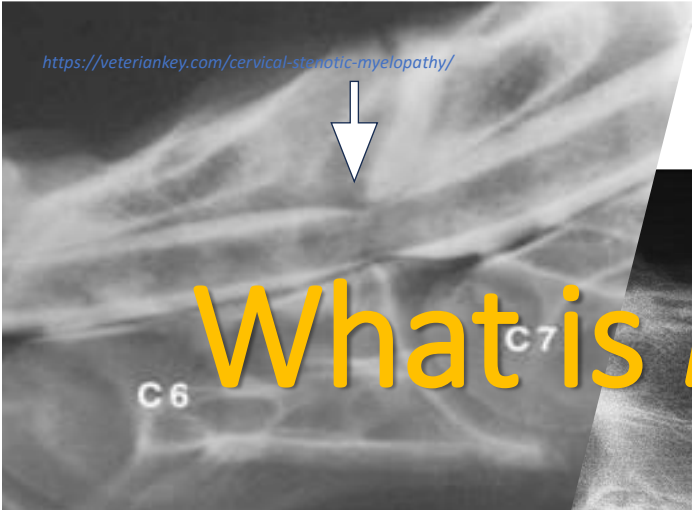


1

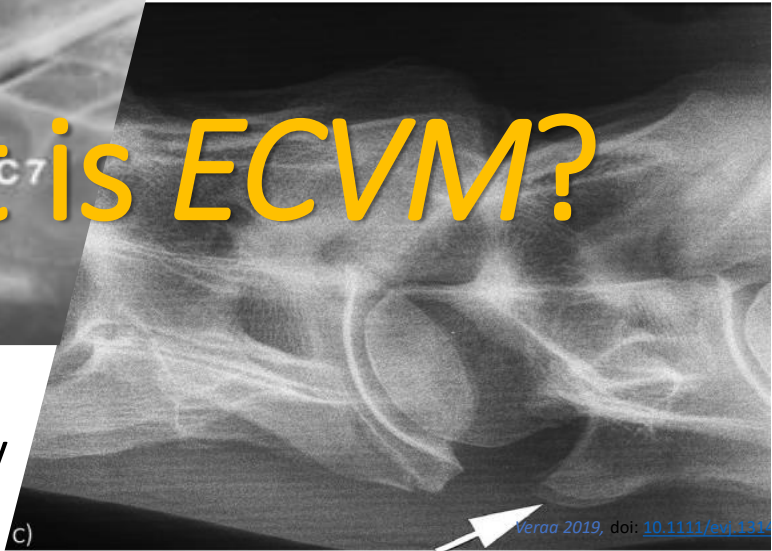


2



• Equine Complex Vertebral Malformation

# What is *ECVM*?



• Equine Cervical Vertebral Myelopathy (Wobblers)

3

4

Journal of Equine Veterinary Science 34 (2014) 1313–1317

- Incidence of 38%\* in Thoroughbreds
- “Compromised structural integrity leads to dysfunction and locomotive ramifications.”

Original

The Occurrence of a Congenital Malformation in the Sixth and Seventh Cervical Vertebrae Predominantly Observed in Thoroughbred Horses

Sharon May-Davis BAppSc (Equine), MAppSc\*  
45 Hall Street, ...

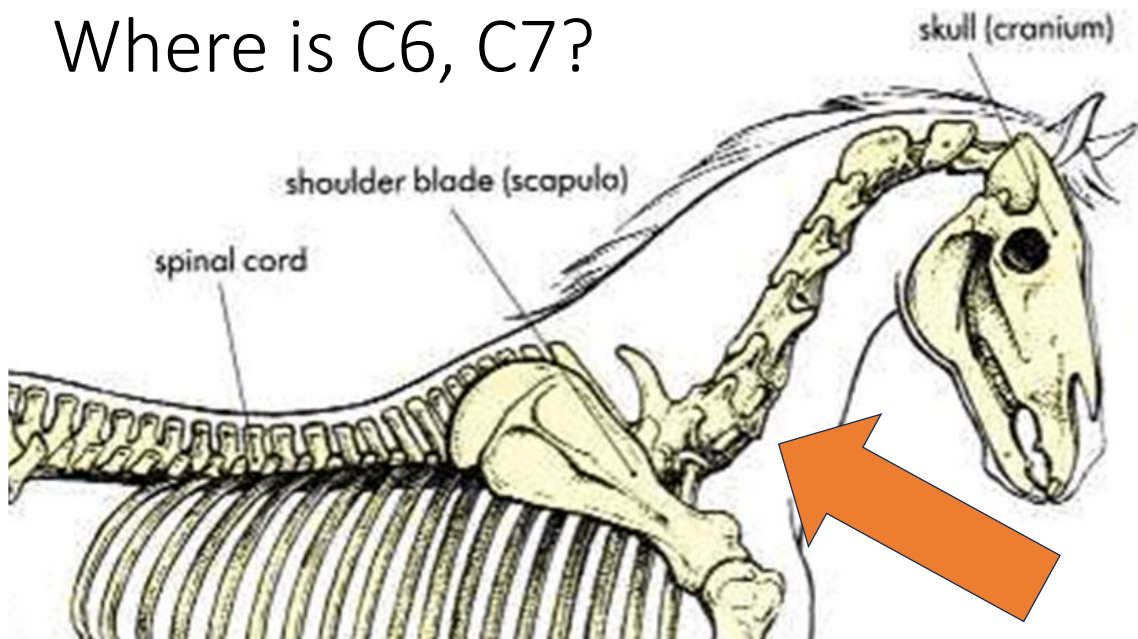
- Muscular changes (N = 9, SM-D 2015)
- Congenital? (N = 1, SM-D 2015)
- Grading system (2023)

ARTICLE INFO ABSTRACT

Article history: ... During the dissection and skeletal examination of 122 horses, it was observed that a

5

Where is C6, C7?

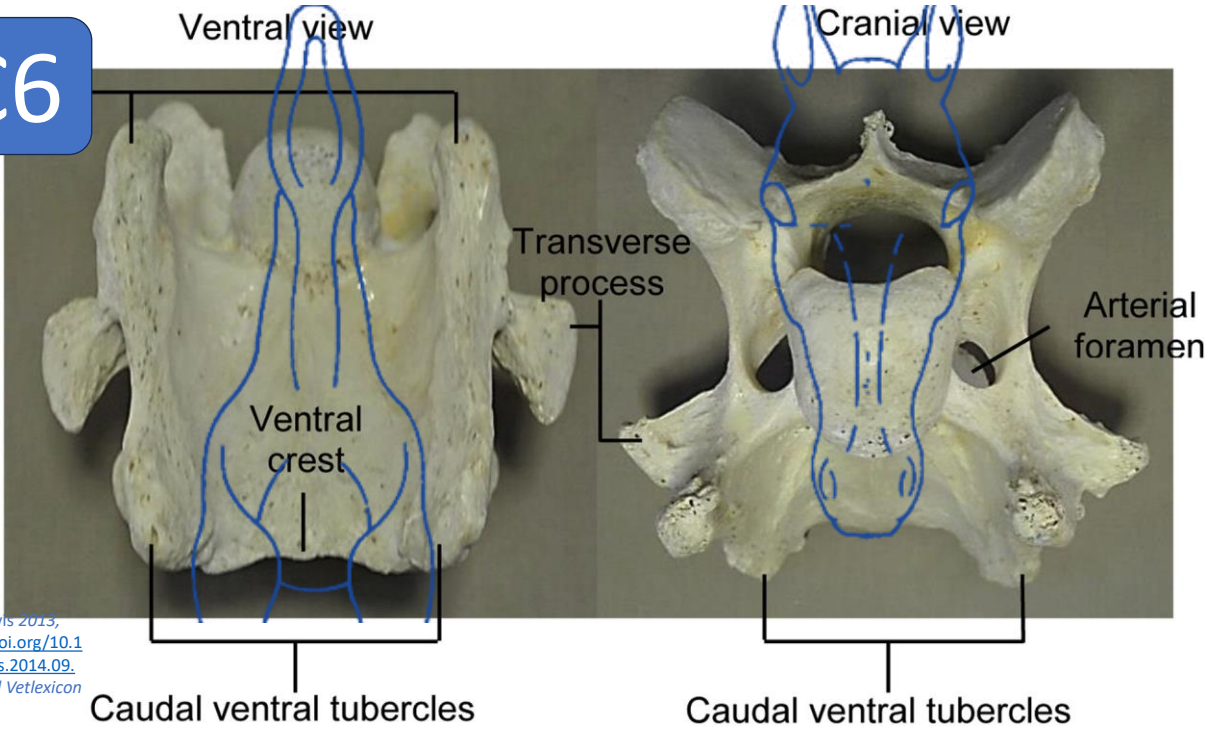


<https://shoestringstable.wordpress.com/2010/04/08/customizing-helpful-photos/asideskeleton/>

6



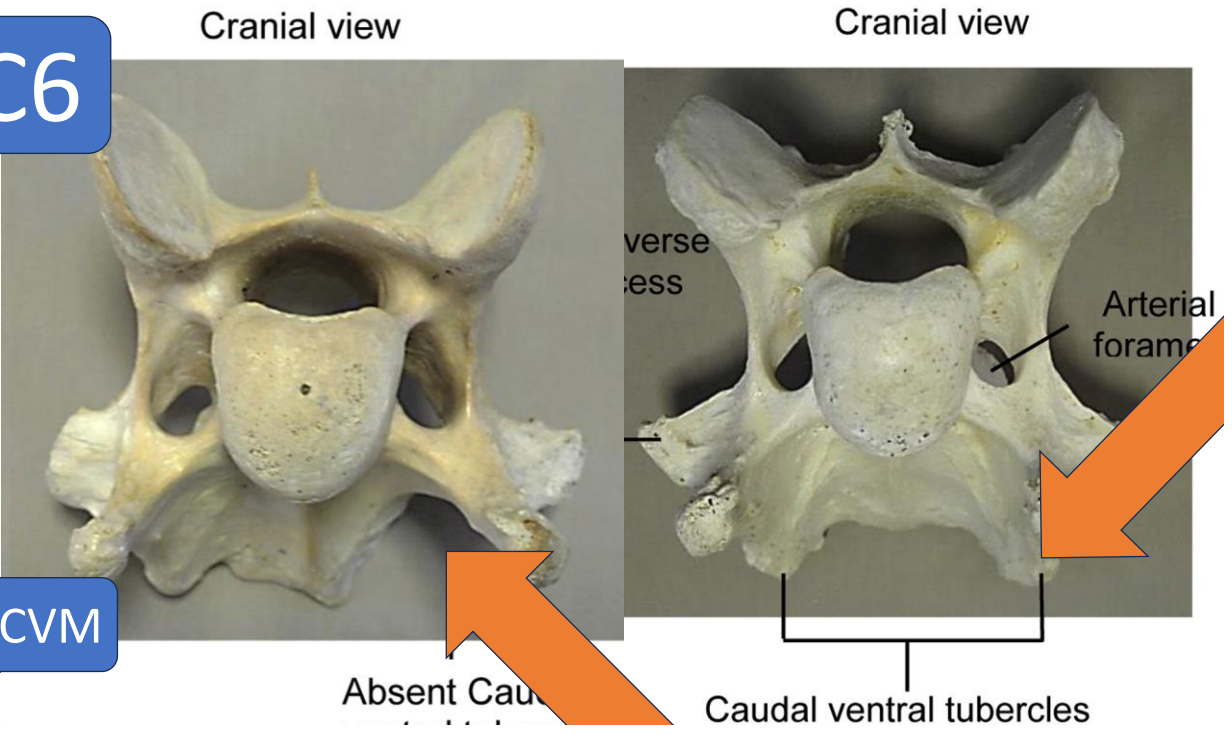
C6



May-Davis 2013, <https://doi.org/10.1016/j.jevs.2014.09.012>, and Vetlexicon

7

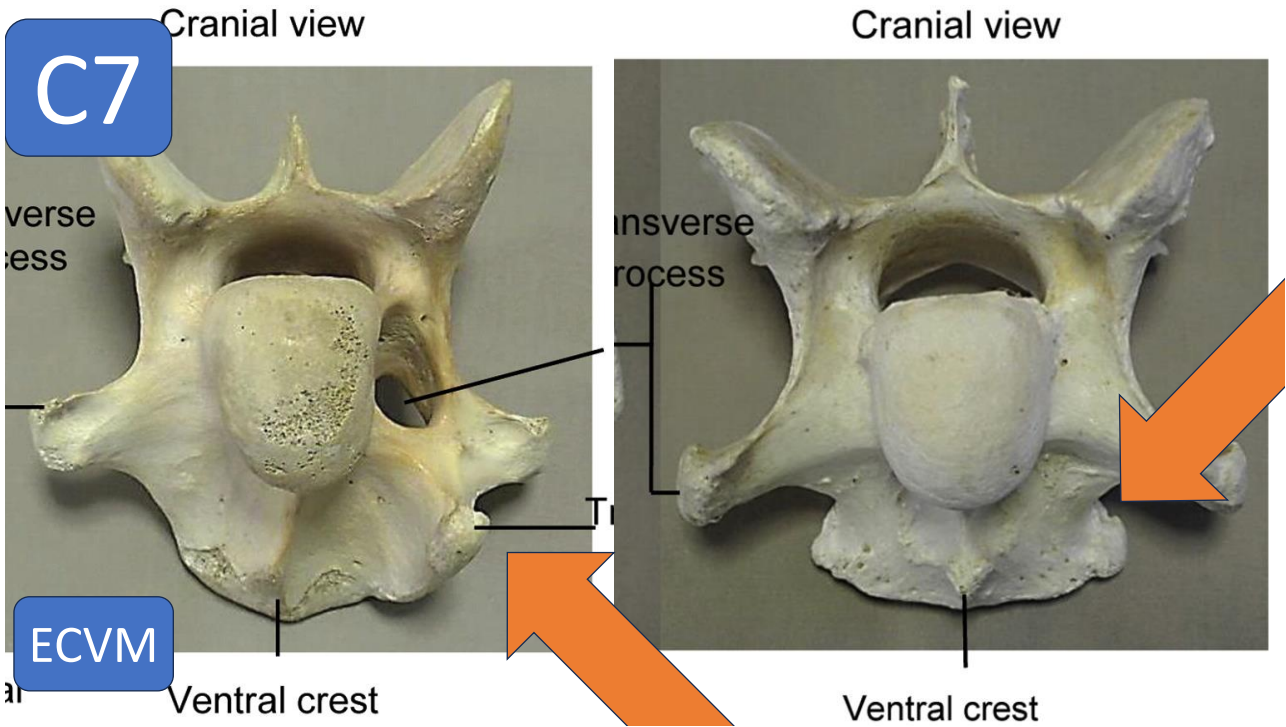
C6



ECVM

012

8



9

**Veraa et al 2019**

- 377 horses
- Radiographic diagnosis
- "...detected more frequently in horses without clinical signs."

**Becatti et al 2020**

- 116 horses
- Radiographic diagnosis
- "...increase the odds of showing neck pain and, if severe, ataxia."

10



BEVA Equine Veterinary Journal

## Veraa et al 2019

**Caudal cervical vertebral morphological variation is not associated with clinical signs in Warmblood horses**

S. VERA<sup>1</sup>\*, K. DE GRAAF<sup>2</sup>, L. D. WINBERG<sup>3</sup>, W. BACK<sup>4</sup>, H. VERNOOI<sup>1</sup>, M. NIELLEN<sup>1</sup> and A. J. M. BELL<sup>1</sup>

**• Observed ECVM in diverse breeds**

**• Clinical outcomes, not performance**

**• Did not gather DNA??**

## Becatti et al 2020

**Radiographic findings and anatomical variations of the caudal cervical area in horses with neck pain and ataxia: a case-control study on 116 horses**

**• Observed ECVM in diverse breeds**

**• Clinical outcomes, not performance**

**• Did not gather DNA??**

11



12



## Santinelli *et al* 2016

### Anatomical variation of the spinous and transverse processes in the 6th and 7th cervical vertebrae and the first thoracic vertebra in horses

I. SANTINELLI, F. BECCATI\*, R. ARCELLI and M. PEPE

Centro Nazionale del Cavallo Sportivo, Dipartimento di Veterinaria, University of Perugia, Perugia, Italy

\*Correspondence: f.beccati@unipg.it

• Significant difference by breed for C7  
• Sex? difference for C6-C7 transposition

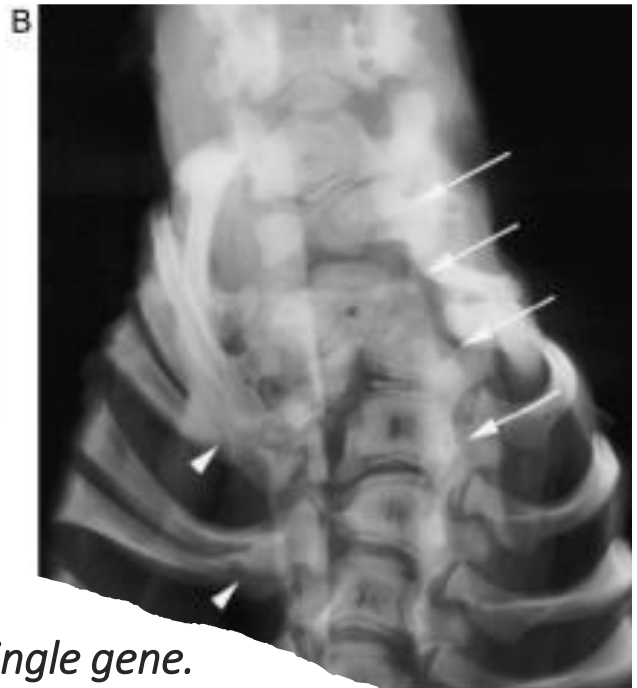
**Objectives:** To identify morphological radiographic variation in the 6th and 7th cervical vertebrae and the first thoracic vertebra in horses of different breeds and to determine whether there are breed- and sex-related differences.

**Study design:** Retrospective descriptive study.

**Methods:** Radiographs of the cervical spine of 270 horses were assessed retrospectively. The Chi-square test, or Fisher's exact test when appropriate, was used to test for associations between radiographic findings and sex or breed, and residual analysis was performed to localise differences. Chi-square tests and calculation of phi coefficient ( $\phi$ ) were used to test for associations between different types of radiological variation.

**Results:** Three variants were identified in the spinous process of the 7th cervical vertebra, and 2 variants were identified in the spinous process of the first thoracic vertebra. The presence of the spinous process of the 7th cervical vertebra was associated with breed, and transposition of the ventral process of the 6th cervical vertebra onto the ventral aspect of the 7th cervical vertebra was associated with sex. The shape of the spinous process of first thoracic vertebra was associated with the shape of the spinous process of the 7th cervical vertebra and with the presence of transposition of the ventral process of the 6th cervical vertebra onto the ventral aspect of the 7th.

13



CVM in cattle: *lethal syndrome, single gene.*

Thomsen *et al.* 2006, doi: 10.1101/gr.3690506

14



4a

4b

4c

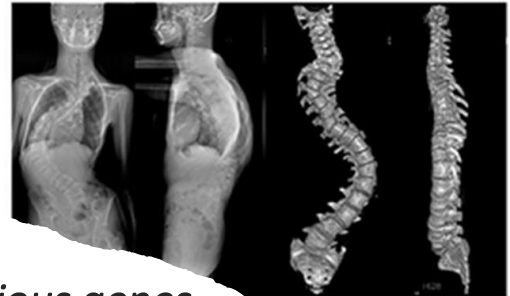
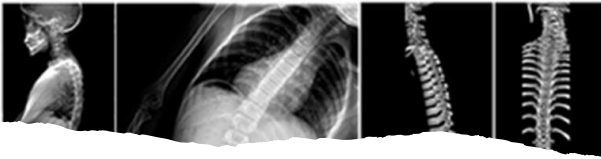


5a

5b

5c

5d



CVM in people: diverse *syndrome*, *various genes*.

Al Daheri doi: [10.1002/ajmg.a.61607](https://doi.org/10.1002/ajmg.a.61607) 7d

15

## What *have* we learned about ECVM?

- Reported initially in *CASE STUDIES*
- Biomechanical and welfare implications, *UNKNOWN*
- Genetic component, *UNKNOWN*
- Research is needed!

16





17

Research in Veterinary Science 150 (2022) 65–71

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Research in Veterinary Science

journal homepage: [www.elsevier.com/locate/rvsc](https://www.elsevier.com/locate/rvsc)

## Genomic loci associated with performance limiting equine overriding spinous processes (kissing spines)

L. Patterson Rosa<sup>a,1,\*</sup>, B. Whitaker<sup>b,1</sup>, K. Allen<sup>c</sup>, D. Peters<sup>d</sup>, B. Buchanan<sup>b</sup>, S. McClure<sup>e</sup>, C. Honnas<sup>f</sup>, C. Buchanan<sup>b</sup>, K. Martin<sup>a</sup>, E. Lundquist<sup>a</sup>, M. Vierra<sup>a</sup>, G. Foster<sup>a</sup>, S.A. Brooks<sup>g</sup>, C. Lafayette<sup>a,\*</sup>

<sup>a</sup> Etalon, Inc, Menlo Park, CA 94025, USA

<sup>b</sup> Brazos Valley Equine Hospitals, Salado, TX 76571, USA

<sup>c</sup> Virginia Equine Imaging Center, The Plains, VA 20198, USA

<sup>d</sup> East-West Equine Sports, Lexington, KY 40583, USA

<sup>e</sup> Midwest Equine, Boone, IA 50036, USA

<sup>f</sup> Texas Equine Hospital, Bryan, TX 77807, USA

<sup>g</sup> Department of Animal Science, UF Genetics Institute, University of Florida, Gainesville, FL 32610, USA

18

Grade 0 (Non-affected control)

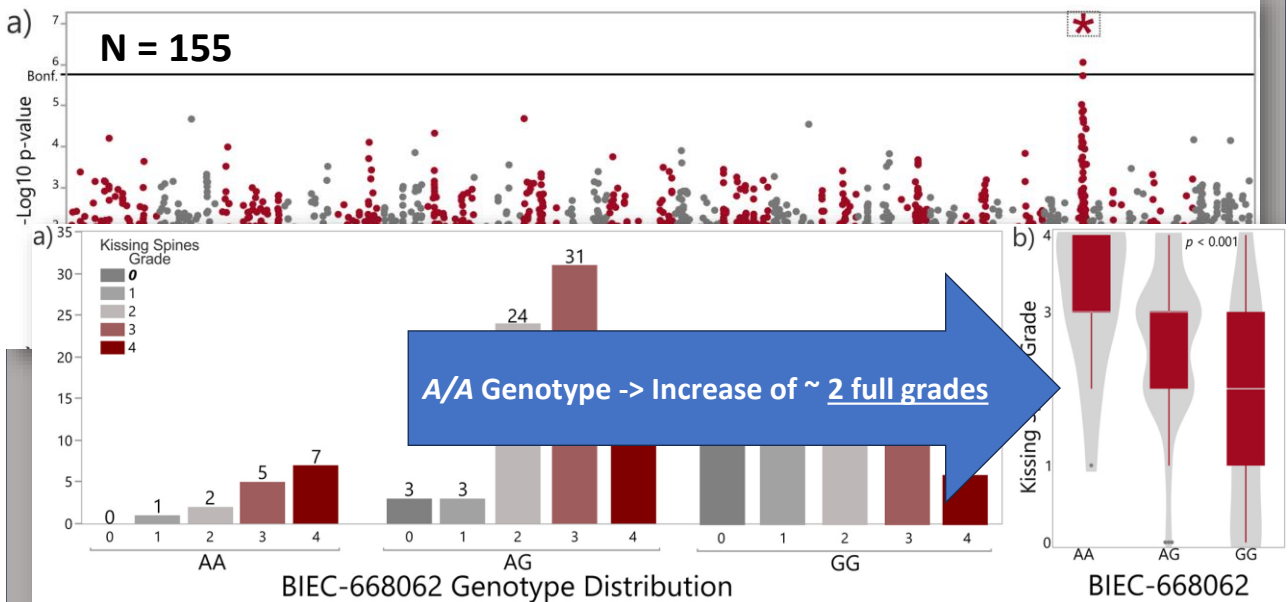
Grade 1

Grade 2

# What is *KS*?

- Impingement, overriding DSP  
-> pain, inflammation, calcification

19

Rosa et al 2022, <https://doi.org/10.1016/j.rvsc.2022.06.015>

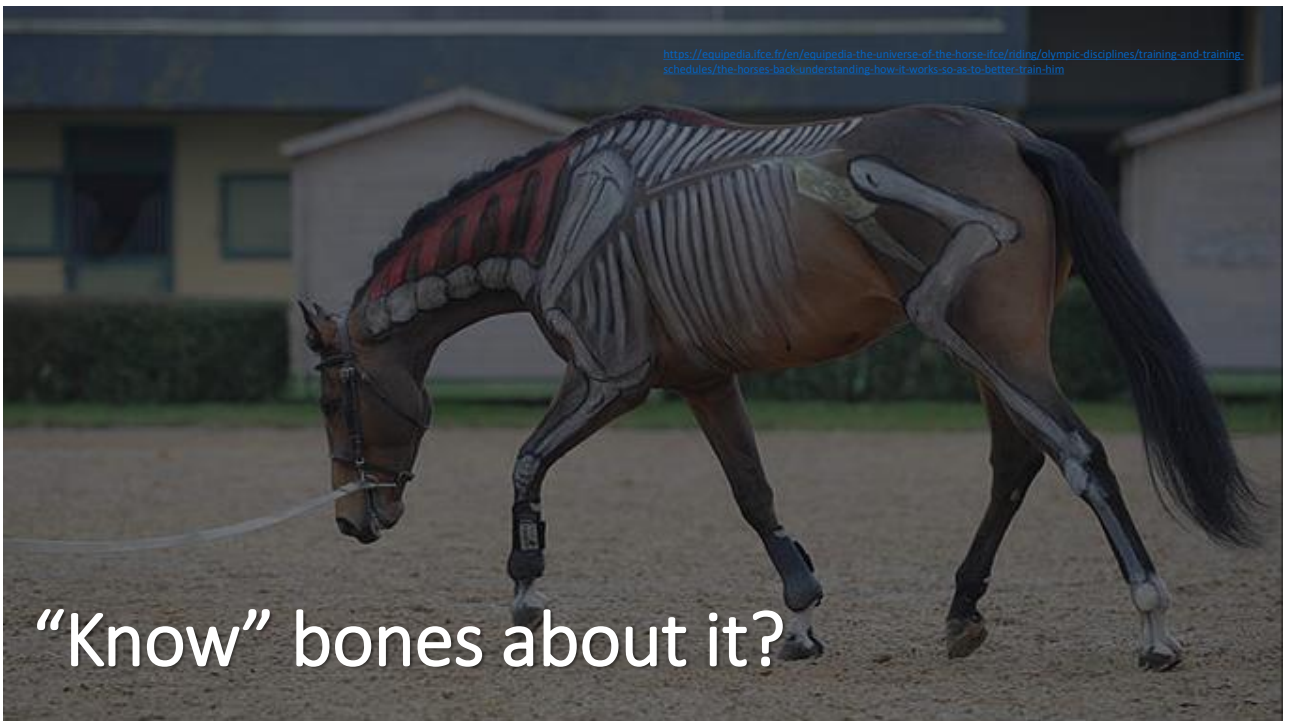
20

Is two KS  
Grades  
relevant?



21

<https://equipedia.lfce.fr/en/equipedia-the-universe-of-the-horse/lfce/riding/olympic-disciplines/training-and-training-schedules/the-horses-back-understanding-how-it-works-so-as-to-better-train-him>



“Know” bones about it?

22



Gold Standard:  
Visual Assessment



23



24

# Where's the Scientist?

2019 Instagram post by USEA



25

0/19 img014.png

- Adjust marker size.
- Select a bodypart to label
- rightHoof
- rightHhoof
- righthock
- rightFfetlock
- rightHfetlock
- rightknee
- handlerRfoot
- handlerRknee
- nostril
- poll
- withers
- shoulder
- elbow
- croup
- hip
- stifle
- pointofbuttock
- leftHoof
- leftHhoof
- lefhock
- leftFfetlock
- leftHfetlock
- leftknee
- handlerLfoot
- handlerLknee

Load frames
<<Previous
Next>>
Help
Zoom
Home
Pan
 Lock View
Save
Quit

Zoom On

26





27

### Video Processing

Convolutional Neural Network (CNN)

DeepLabCut :  
a software package for  
animal pose estimation

H)

Smythe et al. Under Review

28





29

## What we know from Ehlers-Danlos (Human *PLOD1* gene)



- Ocular, spinal and vascular disease
- Aortic dissection/rupture, strokes
- Increased height, joint hypermobility, narrow chest
- Recessive??
  - Carrier parents of affected children have 54%, 86% normal enzyme activity



<https://omim.org/entry/153454>

<https://www.bluespringwellness.com/blogs/e/ehlers-danlos-syndrome>

30

The screenshot shows the eurodressage.com website. The main article is titled "U.S. Breeders and Stallion Owners on Alert for Warmblood Fragile Foal Syndrome". A secondary article is titled "WFFS sweeps the breeding world...". Another article snippet is visible: "Dark Ronald xx, Not Origin Horse for Warmblood Fragile Foal Syndrome (WFFS)". The website header includes navigation links: HOME, DRESSAGE, SHOW/JUMPING, EVENTING, HORSE HEALTH & RIDER FITNESS, BREEDERS CLUB, DIRECTORIES. The footer shows the date "Tue, 07/07/2020 - 09:25".

31

Abbondi et al. *Genetics Selection Evolution* (2022) 54:4  
<https://doi.org/10.1186/s12711-021-00693-4>

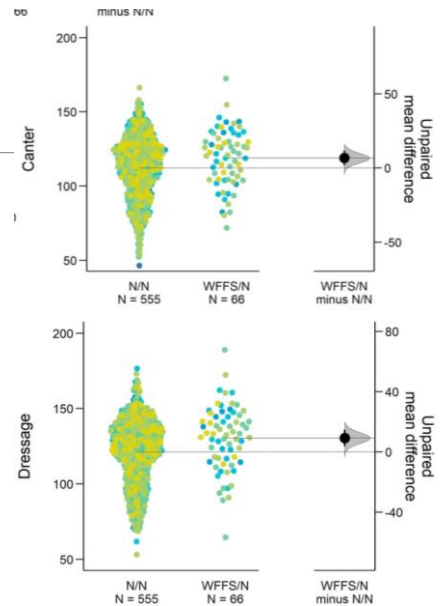
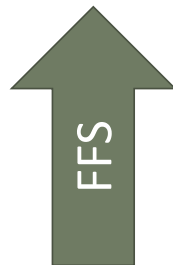


RESEARCH ARTICLE

Open Access

### Performance of Swedish Warmblood fragile foal syndrome carriers and breeding prospects

Michela Ablondi<sup>1\*</sup>, Martin Johansson<sup>2†</sup>, Susanne Eriksson<sup>2</sup>, Alberto Sabbioni<sup>1</sup>, Asa Gelinder Viklund<sup>3†</sup> and Sofia Mikko<sup>2†</sup>

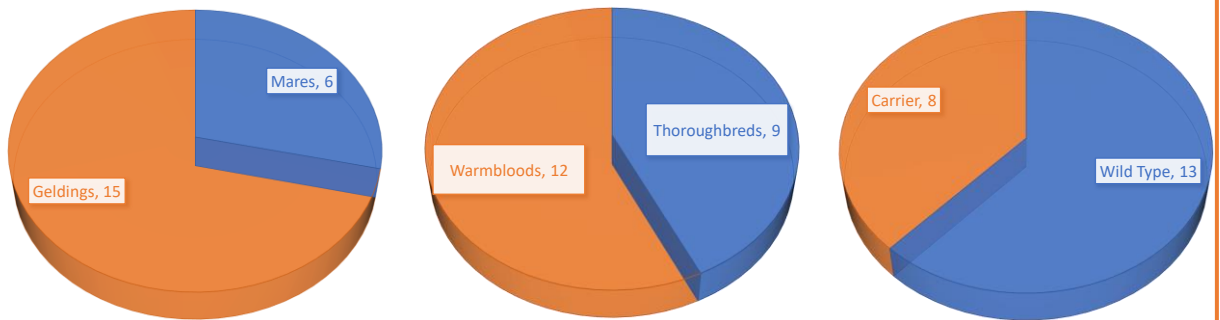


<https://jsejournal.biomedcentral.com/articles/10.1186/s12711-021-00693-4>  
<https://eurodressage.com/2017/10/13/classical-training-lesson-canter>

32

## Does one copy of *FFS* alter gait?

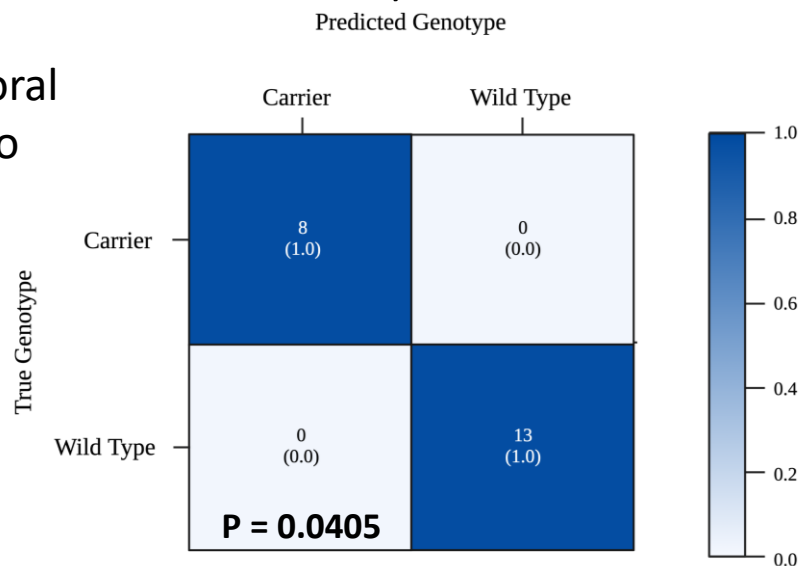
- N=21
- Privately Owned Sport Horses
- 7 locations



33

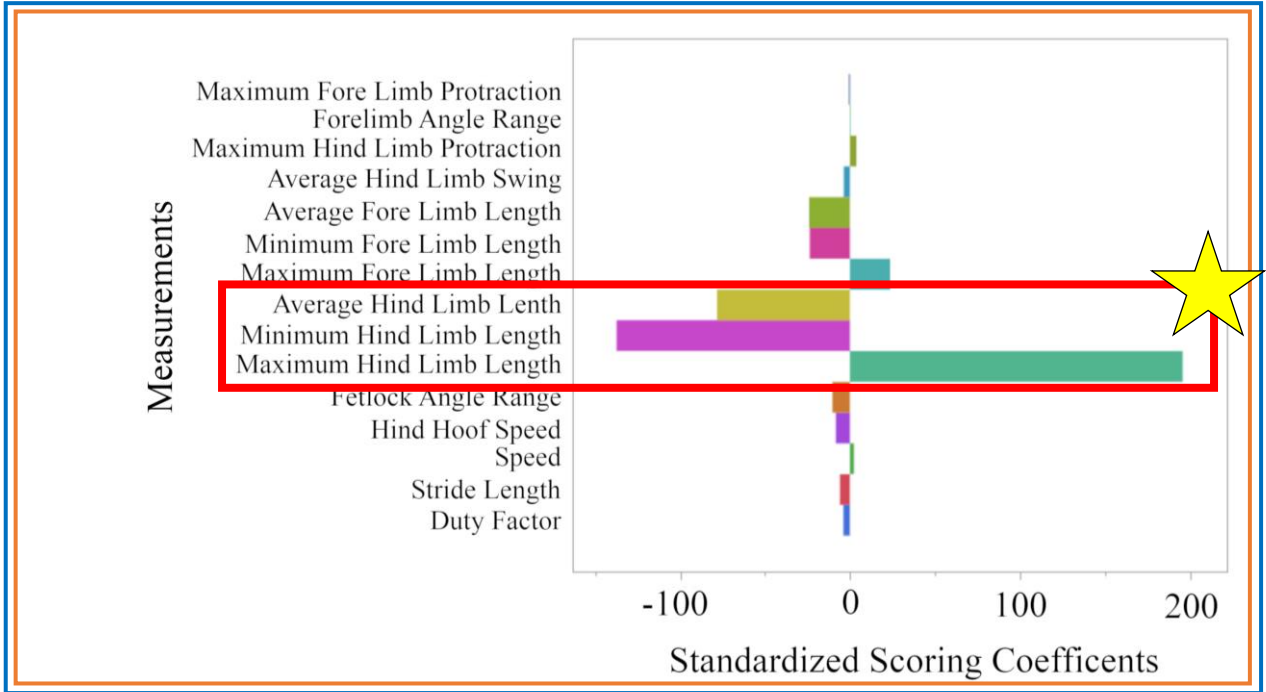
## Quadratic Discriminant Analysis

- 15 spatiotemporal gait measures to predict *FFS* genotype

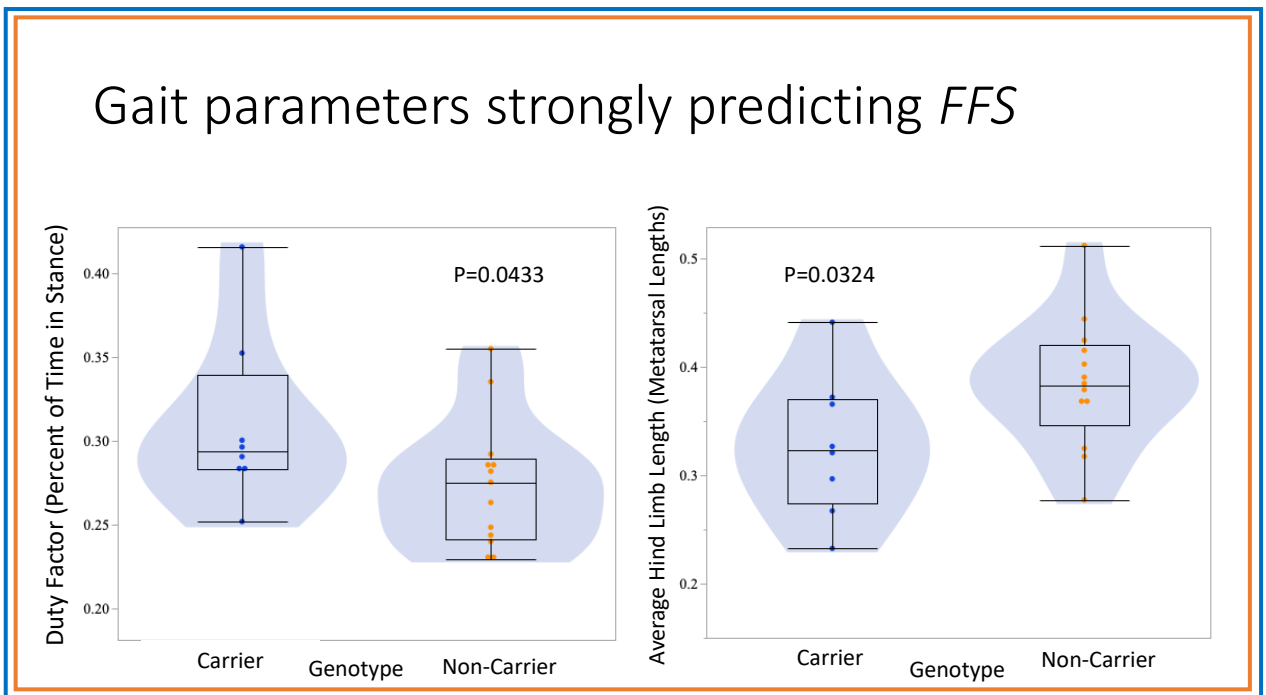


34

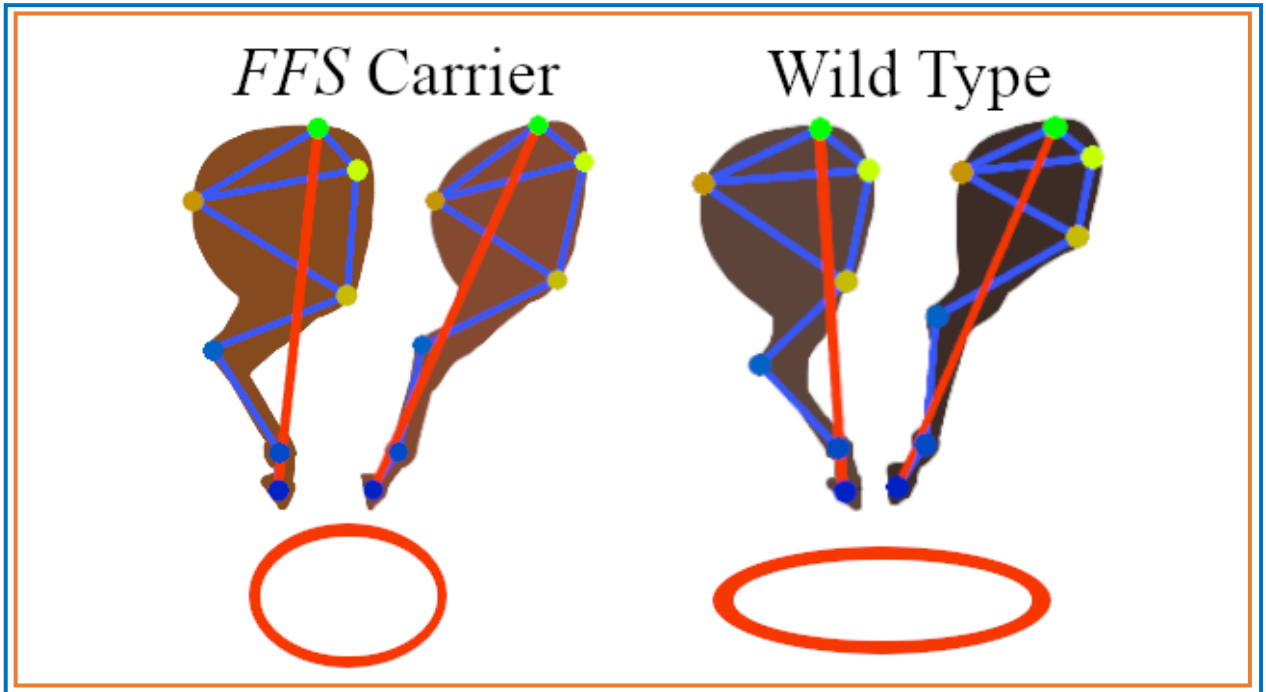




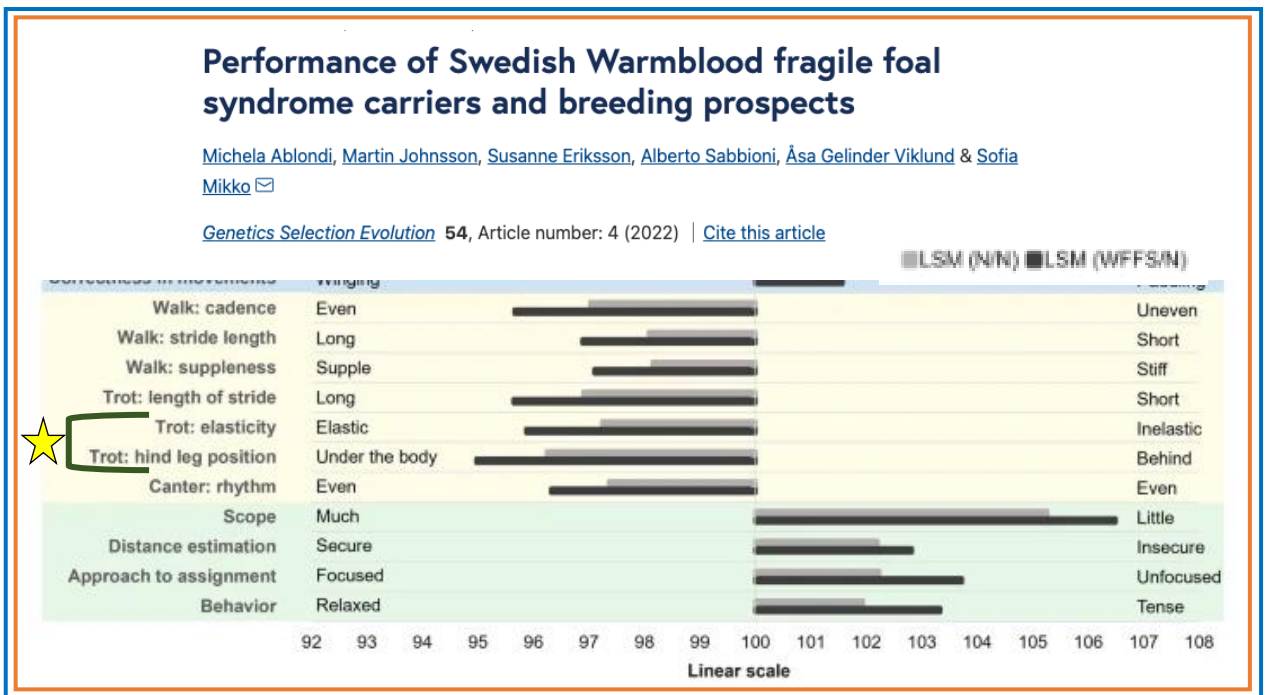
35



36



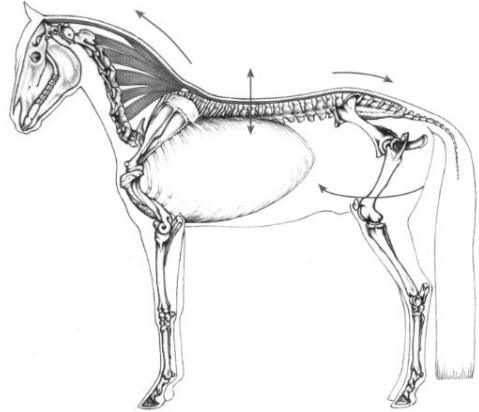
37



38

Rhodin, 2008, [https://pub.epsilon.slu.se/1680/1/Rhodin\\_2008\\_1.pdf](https://pub.epsilon.slu.se/1680/1/Rhodin_2008_1.pdf)

- Not all elastic movers have FFS!
- Soft tissue needs consideration.
- We must consider new technologies.



*Fig. 7* A horse in “relative elevation” with a released back allowing the muscles to work properly will be able to easily lower the croup. Thereby, it will be able to step far forward under its body and the centre of gravity (see arrows). (Adapted from: Heuschmann, 2007).



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[https://www.uff.ufl.edu/give-now/?fund\\_id=020217](https://www.uff.ufl.edu/give-now/?fund_id=020217)









40





Mares and foals grazing at the UF-ESC

**QUESTIONS? EQUINEGENETICS@IFAS.UFL.EDU**

