Deformities in Atlantic salmon, Field and experimental observations (2016-2018)

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Spinal deformites in Atlantic salmon.
20 different types/combinations described in x-rays

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Towards a classification and an understanding of developmental relationships of vertebral body malformations in Atlantic salmon (*Salmo salar* L.)

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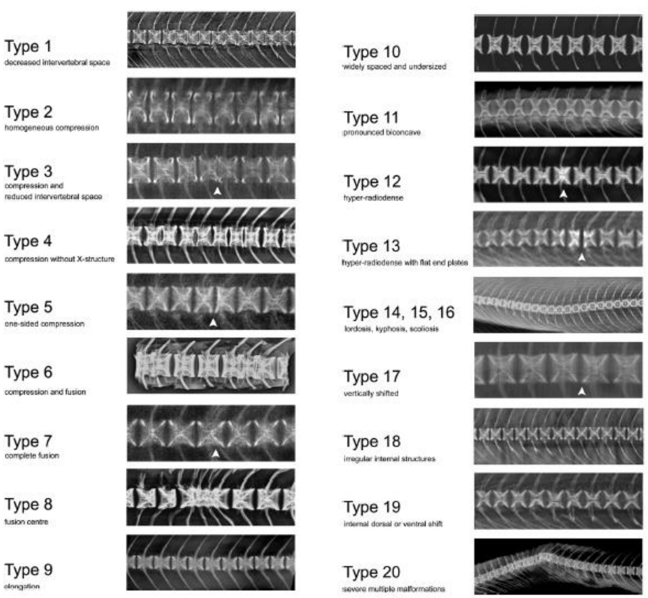

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Deformities in Atlantic salmon, Field and experimental observations (2016-2018)

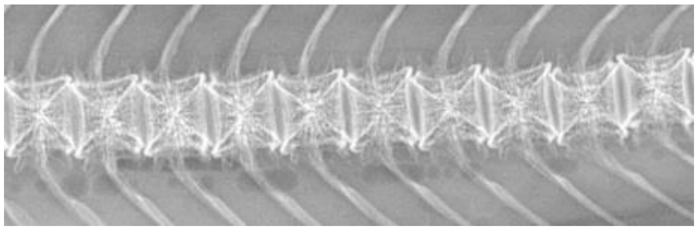
A. Field observations

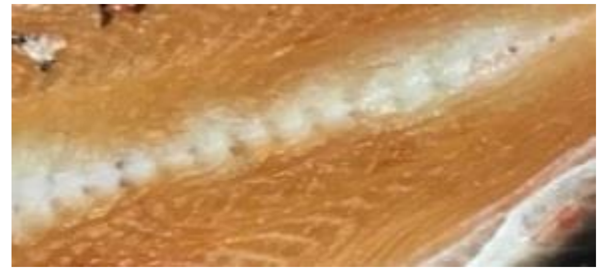
B. Experimental trial

C. «Big Data» based on three generations

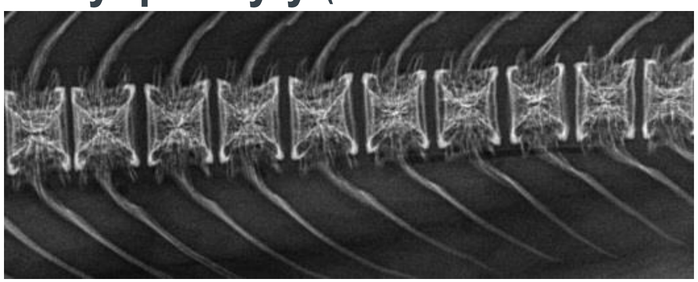
There are different types of spinal deformities (evident by X ray) that can result in connective tissue/cartilage development. Examples 3 main types

Cross stich





Platyspondyly **(some risks described in literature)**



Fusions **(some risks described in literature)**

Farm cases: Fish population (farmers choice) X-ray assessment at slaughter (n=30-60)

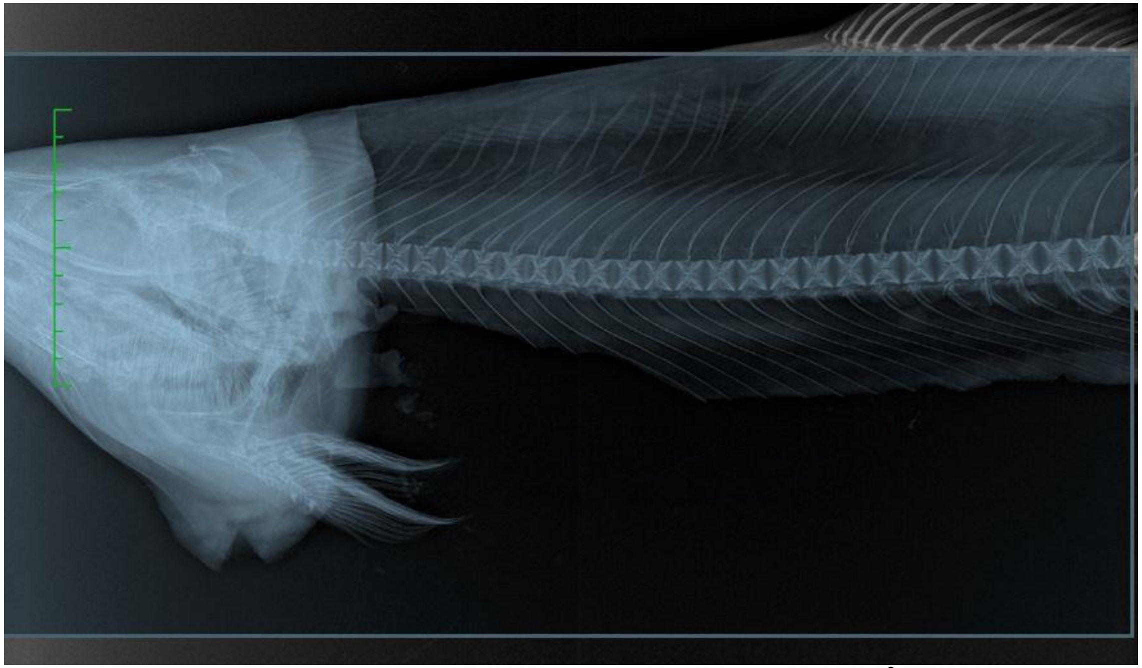
Farm	Vaccine (all 6 comp + PD)	Prevalence fish with X-ray findings	Fusions	Platyspondyly	X-stich
1 S1-16	**7-component** In use since 2015	**12%**	**10%**	**0%**	**2%**
2A S0-16	**7-component** In use since 2015	**83% ***	**47%**	**63%**	**7%**
2B S0-16	**7-component** In use since 2015	**43% ***	**13%**	**30%**	**7%**
3A S1-17	**7-component** In use since 2015	**3%**	**3%**	**0%**	**0%**
3B S1-17	**6+1 combi** In use since 2008	**43%**	**17%**	**0%**	**27%**
4A S1-17	**7-component** In use since 2015	**10%**	**10%**	**0%**	**0%**
4B S1-17	**6+1 combi** In use since 2008	**0%**	**0%****	**0%**	**0%**

- *Several fish had combination of more than one deformity type
- **Deviates from 10% prevalence found at earlier samplings

Spinal deformities, controlled experiment

Design:

- S0 production cycle at research facility (Q3 2017- Q4 2018)
- Groups of fish vaccinated with different experimental and commercial multivalent vaccines vs unvaccinated
- Groups kept together within 2 x 3 replicate cages feed on std basic feed, one triplicate received (in pulses) feed added immune stimulant (B-glucan), while one triplicate receive pulses of identically made feed without immune stimulant.
- X-ray assessment over time (n=30-60)



X-ray picture: VetScan AS

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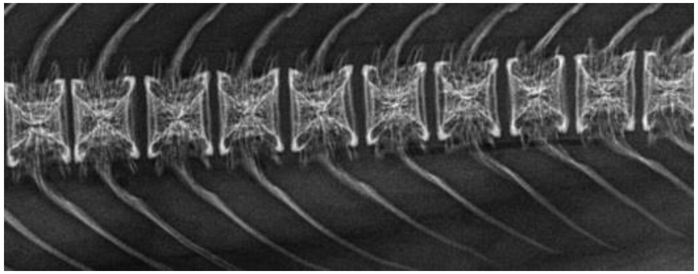
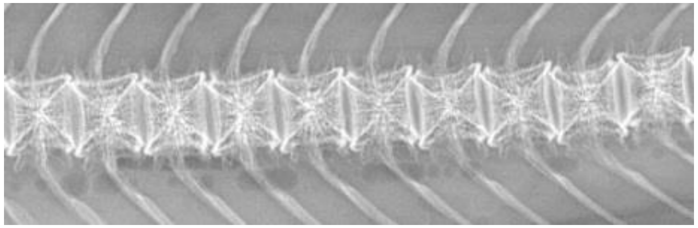
Spinal deformities, controlled experiment

Key finding:

- All the three main types of spinal deformities evident
- Platyspondyly and Fusion evident in all groups **including unvaccinated**
- Cross stich pathology only seen on vaccinated fish when vaccination included PD, independent of vaccine producer and modifications made on experimental vaccines.
- Cross stich pathology first evident 2,5 months before slaughter. Platyspondyly and Fusions evident earlier.
- No effect of pulse feeding with feed added B-glucan was evident *(any feed conclusion is valid for the single ingredient as tested here)*





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Spinal deformity, key observations field and experimental combined

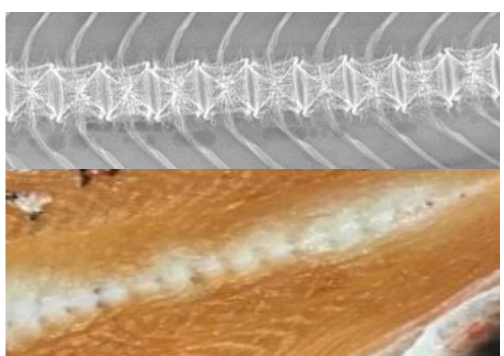
- Various spinal deformities appears to be present in increasing prevalence compared to 4-6 years ago.
- Different deformity types are typically seen in a mix within the same population with big variation in which one predominates.
- Highly variable prevalence and severity between and within farms
- Cross-stich deformity have been observed on fish vaccinated with 4 different vaccines from two producers, 3 includes PD.
- Two of the vaccines have been in extensive use (>100mill doses annually) since 2008, hence long before deformity problems «reappeared» to current level.
- Deformity observations appears much more prevalent in Norway vs UK where the same or similar vaccines are in use.

It appears clear that a combination of factors are needed for spinal deformities to develop.

Spinal deformities, can risk factors be identified by “big data”?

- When ever a potential side effect of a veterinary medicinal products (like a vaccine) is suspected it’s the responsibility of relevant health personnel to report this to the producer of the medicinal product or the competent national authority (in Norway NoMA).
- MSD AH has diligently done this for cases were cartilage/connective tissue observations at slaughter were reported as suspected side effect.

MSD-AH have used such cartilage/connective tissue case reports vs overall use of MSD AH products to high level trend “where” in salmon production cartilage/connective tissue appears.



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Where in salmon production do spinal deformities (evident by cartilage/connective tissue at slaughter) appear?

Total use of MSD PD vaccine 2015-2016 (currently slaughtered fish)

Generation	Number of farms	Number of fish
S0-2015	59	32 million
S1-2016	44	28 million
S0-2016	64	64 million

Cartilage/connective tissue reports at slaughter (=mix of spinal deformities)

- By yes/no majority is no
- Some producers overrepresented
- Overall approximately 3-4 fold higher probability of yes for S0 vs S1
- If yes typically more severe on S0
- Distribution of different types of spinal deformities within the data is unknown

Summary spinal deformity observations

Key findings:

- In Norway various spinal deformities that can result in cartilage/connective tissue at slaughter appears to be present in increasing prevalence compared to 4-6 years ago.
- Higher prevalence and severity on S0 fish
- Huge difference in severity and deformity type distribution between and within farms
- Within S0 produced fish some producers are overrepresented
- A combination of factors appears needed for spinal deformities to develop.

Key questions:

- Have we reintroduced deformity risks known from “old days”?
- Have we introduced new risks resulting in the same?
- What are the production parameters that results in the big variation?
- Can we use the big variation seen to reveal risk factors by computer based big Data approach on production variables?

THANK YOU FOR YOUR ATTENTION

AND THANKS TO THE COLLABORATING PARTNERS

HAVFORSKNINGSINSTITUTTET
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Nofima

VetScan AS
CT & MRI Diagnostics

The involved farming companies

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