Osteogenesis Imperfecta

By: Dustin Kim

What is Osteogenesis Imperfecta?

- A rare bone disease affecting approximately 20,000 to 50,000 people in the United States
- Brittle and weak
- Genes are mutated to form alterations in Type I collagen
- Quantitatively or qualitatively

Classifications of OI

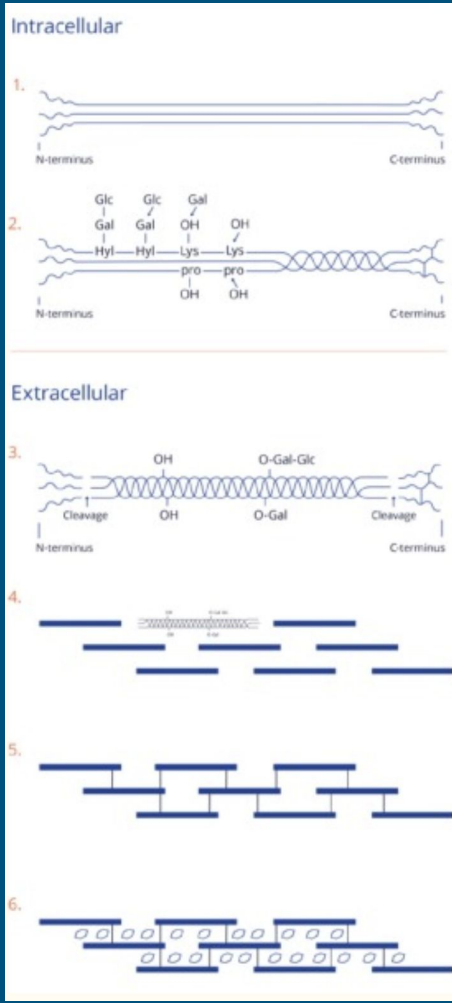
- Type I, II, III, IV OI (autosomal dominant gene) affected by genes *COL1A1* and *COL1A2*
- Type V-XVIII OI (autosomal recessive gene)
- Bone fragility, teeth, the colors of sclera, hearing, the curvature of the spine

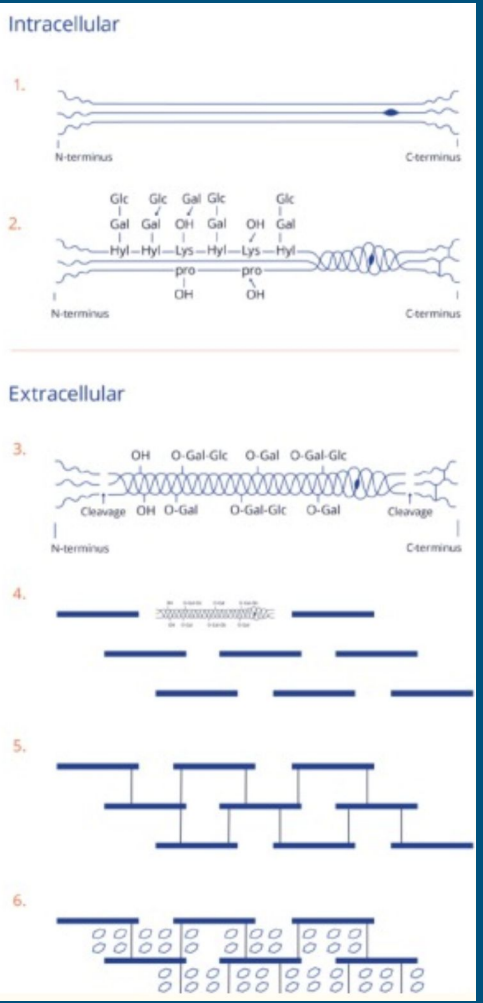
The Effects of OI at a Molecular Level

- Osteoblasts make alpha chains (units of Type I collagen)
- In OI, one alpha chain has an abnormally large amino acid
- Triple helix formation is slowed and hydroxylation & glycosylation is sped up
- The terminal ends of helix is cut off and released in the matrix as a collagen molecule

(cont.)

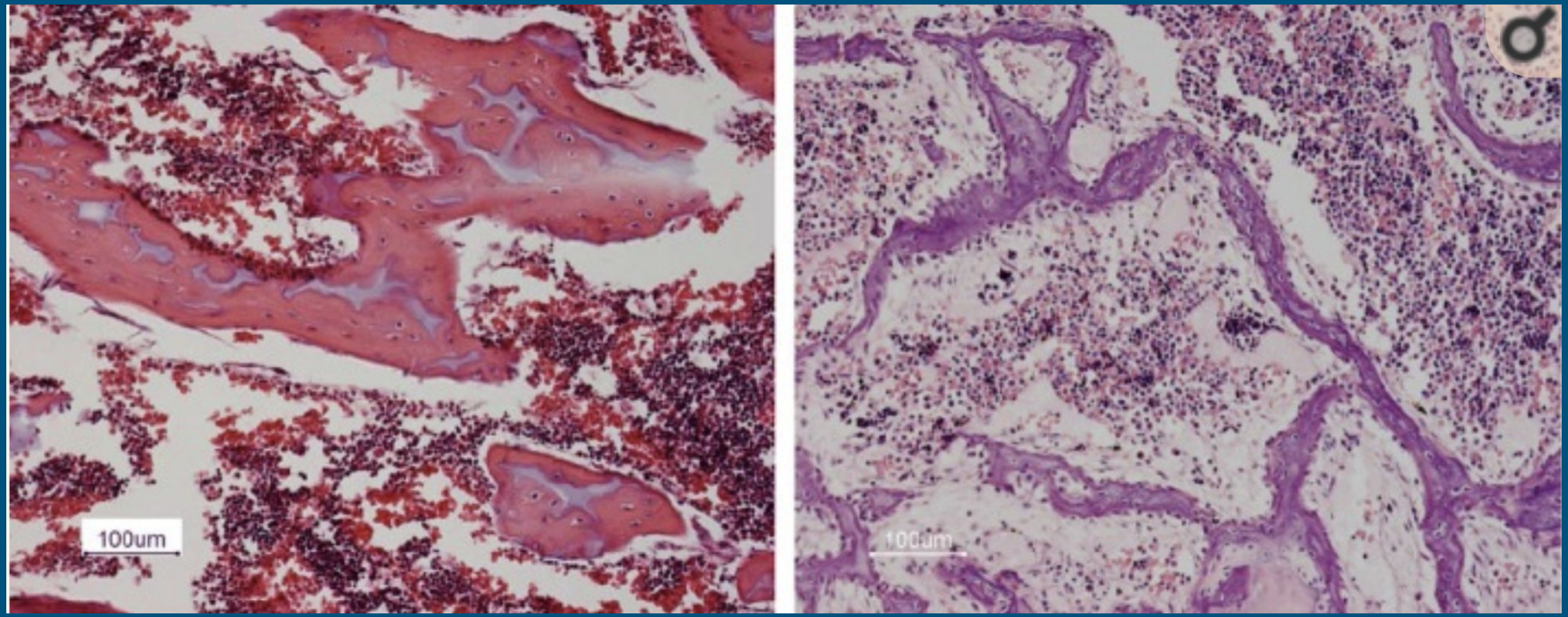
- Multiple collagen molecules make an array that is wider than usual in OI conditions
- Osteoblasts make hydroxyapatite crystals that “fill in the gaps” between the array of collagen molecules
- More space=More mineralization


Intracellular
1.
N-terminus
C-terminus
2.
Glc
Gal
Hyl
Lys
pro
OH
N-terminus
C-terminus
Extracellular
3.
OH
O-Gal-Glc
Cleavage
O-Gal
N-terminus
C-terminus
4.
5.
6.


Intracellular
1.
N-terminus
C-terminus
2.
Glc
Gal
Hyl
Lys
pro
OH
N-terminus
C-terminus
Extracellular
3.
OH
O-Gal-Glc
O-Gal
Cleavage
N-terminus
C-terminus
4.
5.
6.

OI Effects on Bone Tissues

- Increased mineralization in collagen molecules ultimately affects tissues
- Porosity for vascular vessels increases
- Lacunae (space containing osteocytes) widens
- Trabeculae are significantly thinner than how it should be


100um
100um

What now?

- Further research is being done to find solutions to OI
- Vitamin D monitoring and regulation
- Introduction of bisphosphonates used for Osteoporosis
- Single-sperm-based single nucleotide polymorphism haplotyping used for predictions
- OI is still very unknown to us as it is very rare and complex

References

- Barišić, I., Turkalj, M., & Primorac, D. (2017). Osteogenesis imperfecta: clinical assessment and medical treatment. *Paediatria Croatica*, 61(3), 97–105. https://doi.org/10.13112/PC.2017.14
- Chen, L., Diao, Z., Xu, Z., Zhou, J., Yan, G., & Sun, H. (2018). The clinical application Of single-sperm-based SNP haplotyping For Pgd Of osteogenesis imperfecta. *Systems Biology in Reproductive Medicine, 65*(1), 75-80. doi:10.1080/19396368.2018.1472315
- Nijhuis, W. H., Eastwood, D. M., Allgrove, J., Hvid, I., Weinans, H. H., Bank, R. A., & Sakkers, R. J. (2019). Current concepts in osteogenesis imperfecta: Bone structure, biomechanics and medical management. *Journal of Children's Orthopaedics, 13*(1), 1-11. doi:10.1302/1863-2548.13.180190

Thank you