Teichoic acids as master coordinators of growth in *Bacillus subtilis*

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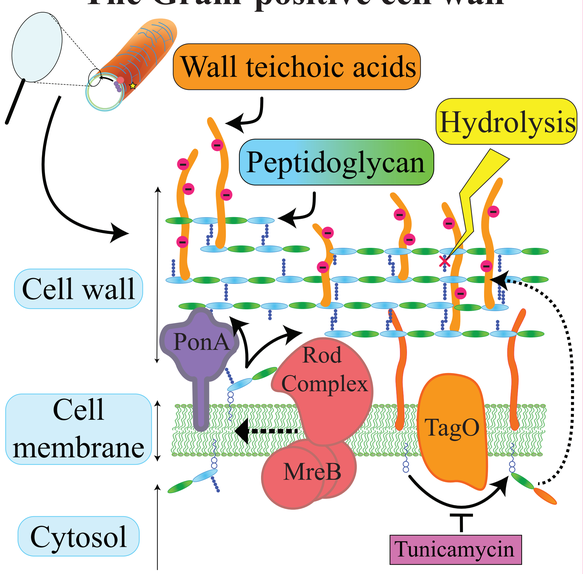
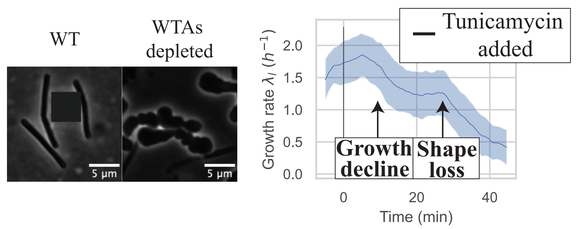
Introduction

Bacillus subtilis's rod-shape results from its circumferentially aligned peptidoglycan meshwork. However, removing wall teichoic acids (WTAs) creates severe defects for both cell shape and growth rate, for unknown reasons. Here, we reveal that wall teichoic acids promote cell shape by activating Rod-complex peptidoglycan synthesis.

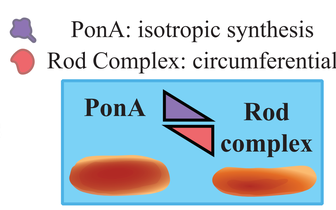
The Gram-positive cell wall



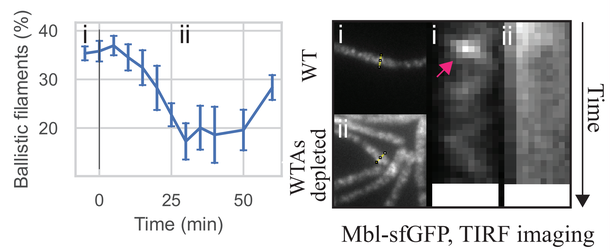
Wall teichoic acids promote cell shape and growth through unknown means



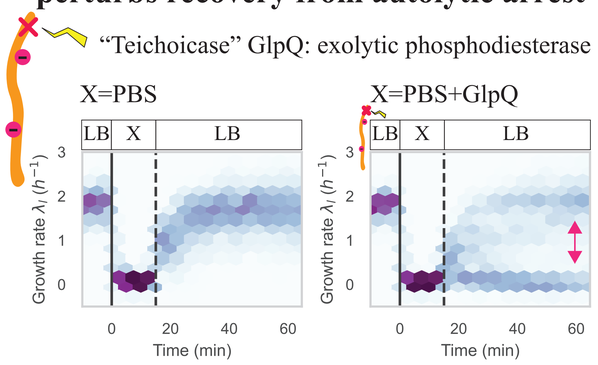
Conundrum: peptidoglycan alignment sets cell width



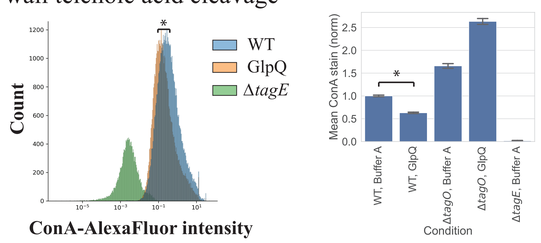
Rod Complex motion declines during wall teichoic acid depletion



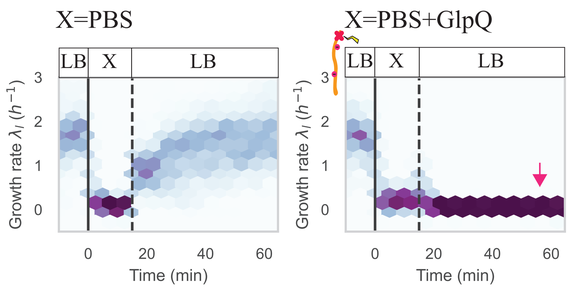
Enzymatically cleaving wall teichoic acids perturbs recovery from autolytic arrest



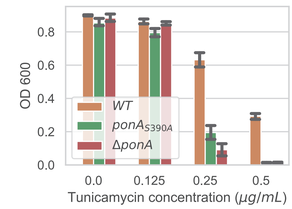
Concanavalin A staining confirms GlpQ-mediated wall teichoic acid cleavage

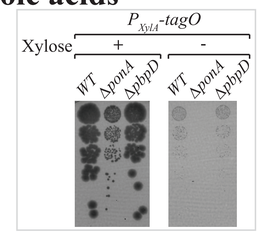


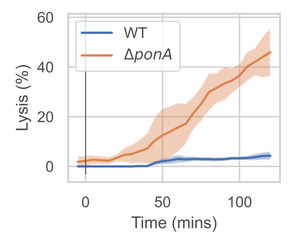
PonA is essential for recovery from wall teichoic acid cleavage

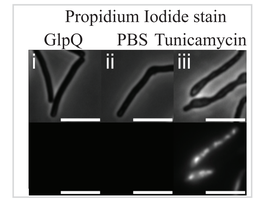


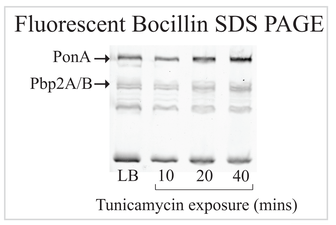
PonA is essential in the absence of wall teichoic acids

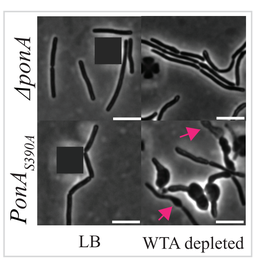




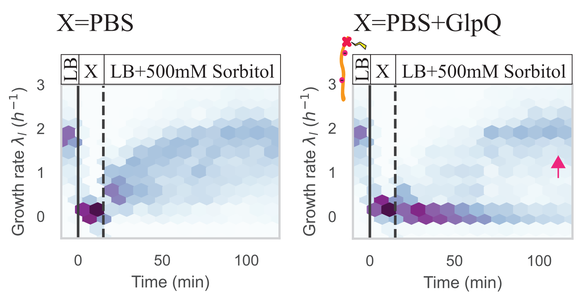




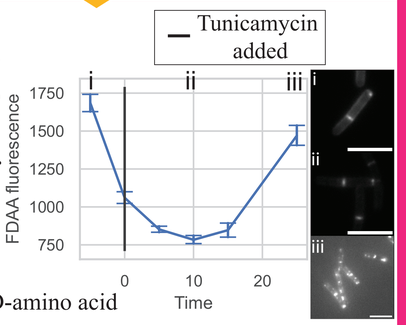




Hyperosmotic shock prompts growth recovery in Δ*ponA* cells after wall teichoic acid cleavage

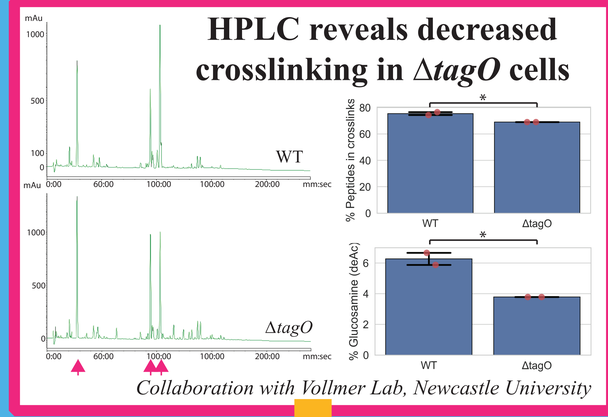


Peptidoglycan crosslinking is perturbed in the absence of wall teichoic acids



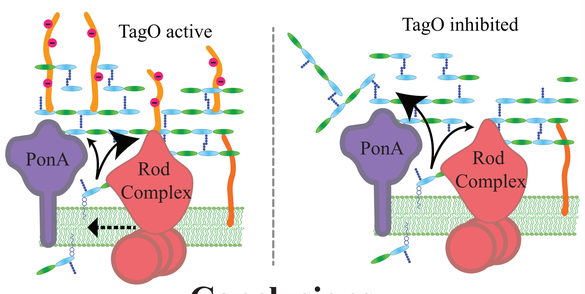
FDAA: Fluorescent D-amino acid

HPLC reveals decreased crosslinking in Δ*tagO* cells



Collaboration with Vollmer Lab, Newcastle University

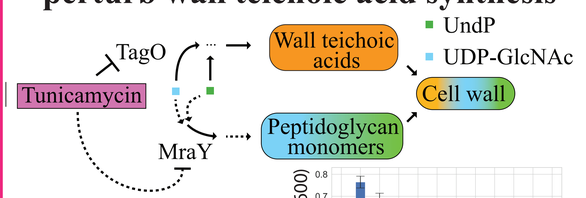
Pothole model



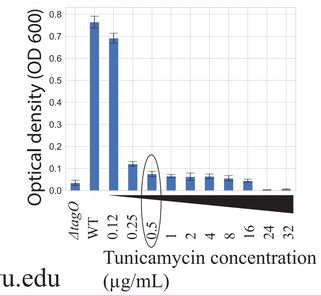
Conclusions

- Wall teichoic acids promote Rod complex activity, conferring rod shape.
- PonA-mediated peptidoglycan insertion sustains growth and loss of shape without wall teichoic acids.
- Contracting the cell wall restores growth in *ΔponA* cells lacking wall teichoic acids, consistent with a "pothole" model.

Low doses of Tunicamycin selectively perturb wall teichoic acid synthesis



Low doses of Tunicamycin mimic *ΔtagO* growth



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