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The Development of Novel Bioresorbable Medical Devices for Treating Diseases of the Anal Canal

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Introduction

Anal abscesses and fistulae-in-ano are the most prominent diseases of the anal canal. Abscesses are pockets of pus caused by accumulating bactera whereas; fistulae-in-ano are hollow tunnels that protrude from the wall of the anal canal to the buttocks. These diseases pose a significant burden on the medical sector and affect a patient's quality of life through associated pain, embarrassing discharge and sexual impairment (Michelassi, et al., 2000).

The transition from biologically stable materials to bioresorbable ones has become increasingly favourable among clinicians; due to the associated issues with current implant biocompatibility and the disadvantages of conducting revision surgeries (Nair & Laurencin, 2007). Our focus is to modify the innate characteristics of polydioxanone (PDO), a synthetic bioresorbable polymer, to support the regeneration of proximal tissue while locally delivering drugs.

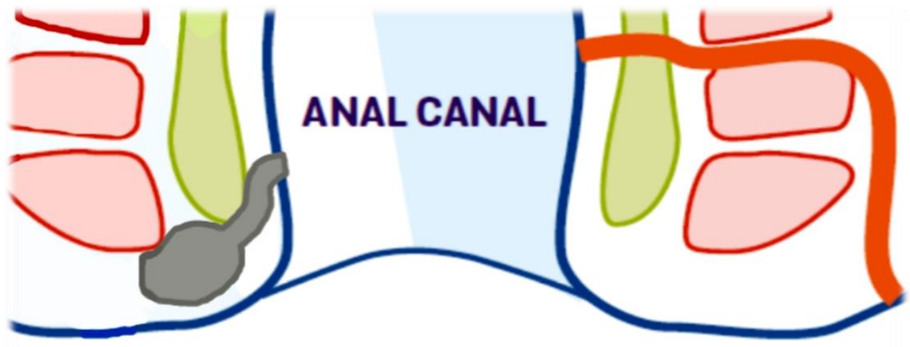


Figure 1. Diagram of anal abscess (Grey) and fistulae-in-ano (Orange), internal / external sphincter (Green / Red). Diagram recreated from (Living with a Fistula | Crohn's & Colitis UK, 2016)

Aims and Objectives

1. Review literature of biomaterials utilised currently for treating anal abscesses and fistulae-in-ano.

2. Develop polydioxanone (PDO) into a tunable composite by electrospinning and chemical modification.

3. Assess capacity of medical devices for functionalisation with appropriate analgesic and antimicrobial agent.

Desired Device Characteristics

- Regenerative capacity.
- Durable up for 12 – 16 weeks
- Ease of application in clinical setting
- Non-toxic composite or degradation products.
- Sustained release of analgesic/antimicrobial agent.

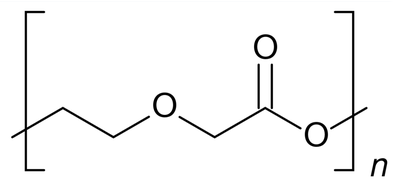


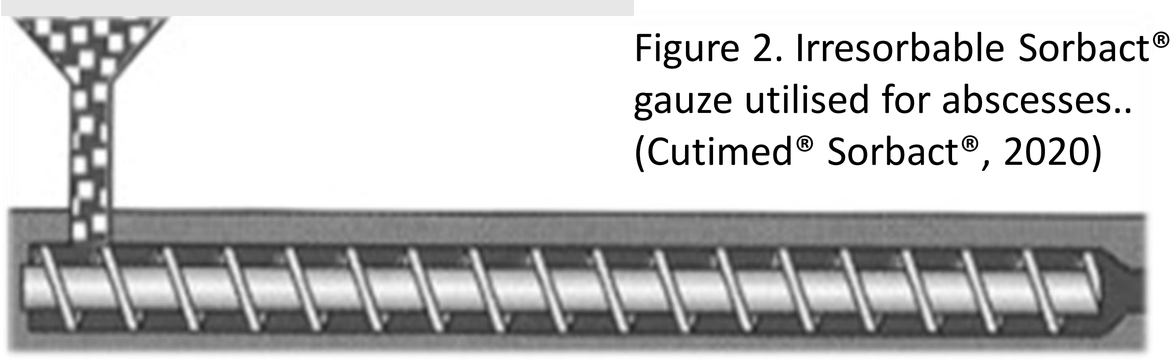
Figure 3. Molecular structure of polydioxanone

Methodologies

Table 1. Extrusion parameters of PDO processing intomesh scaffold

Screw Zone	Temperature (°C)
Feed Throat	20
Zone 1	95 – 105
Zone 2	95 – 105
Zone 3	105 – 115
Nozzle	110 – 120
Mold	25

Figure 2. Irresorbable Sorbact® gauze utilised for abscesses.. (Cutimed® Sorbact®, 2020)



Conclusion

The development of these medical devices will greatly expand the current understanding of polydioxanone. This project will be the first to modify PDO into a gel matrix. In a discussion with Dr. Phillip Tozer of St. Mark's Hospital, the key component missing is "a suitable bioresorbable scaffold that allows the wound to heal sufficiently".

References

Michelassi, F., Melis, M., Rubin, M. and Hurst, R., 2000. Surgical treatment of anorectal complications in Crohn's disease. *Surgery*, 128(4), pp.597-603.

Nair, L. and Laurencin, C., 2007. Biodegradable polymers as biomaterials. *Progress in Polymer Science*, 32(8-9), pp.762-798.

Bsnmedical.com. 2020. *Cutimed® Sorbact®*. [online] Available at: <https://www.bsnmedical.com/products/wound-care-vascular/category-product-search/advanced-wound-care/wound-bed-preparation/cutimedr-sorbactr.html> [Accessed 10 June 2020].

Crohnsandcolitis.org.uk. 2020. *Living With A Fistula | Crohn's & Colitis UK*. [online] Available at: <https://www.crohnsandcolitis.org.uk/about-crohns-and-colitis/publications/living-with-a-fistula> [Accessed 5 June 2020].

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