2021 Best Research Poster Award

Barwon Health

DEAKIN UNIVERSITY

Simulating the effect of glenohumeral capsulorrhaphy on kinematics and muscle function

Project Team Leader: Dr Aaron Fox
Project Team Members: Dr Jason Bonacci, Dr Stephen Gill, Prof Richard Page

INTRODUCTION

Surgical glenohumeral capsulorrhaphy treats glenohumeral instability caused by elongated, lax or damaged structures[1-2]

Glenohumeral capsulorrhaphy includes various techniques involving selective plication to different joint capsule sections (see Fig. 1)[1-3]

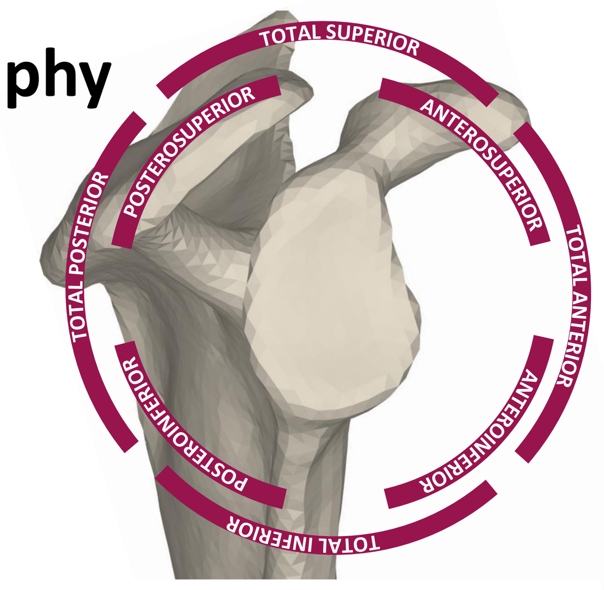


Fig 1. Schematic of the glenohumeral joint location plicated during surgical capsulorrhaphy

While correcting for instability, 'tightening' the joint capsule restricts range of motion[1,4,5]

Restricted range of motion following glenohumeral capsulorrhaphy may make achieving shoulder postures during daily activities difficult for patients. Further, the muscular effort may increase during such tasks to counter the added passive resistance from the joint capsule.

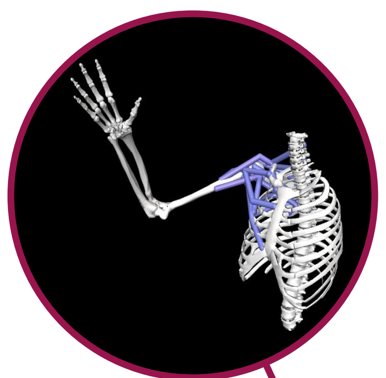
Predictive simulations can help identify cause and effect relationships between musculoskeletal system changes to movement and neuromuscular strategies

This could provide surgeons with an understanding their procedures may have on daily function, and provide a targeted approach to rehabilitation

OBJECTIVE

Use predictive simulations to examine shoulder kinematics, muscular effort, and task performance during upper limb movements under simulated selective glenohumeral capsulorrhaphy conditions

METHOD



Musculoskeletal models of selective capsulorrhaphy were created

Passive restraints were modelled to emulate reduced range of motion described in existing literature[1]

Predictive simulations of upper limb movements were generated

A forward reach, upward reach and head touch task were simulated with each model (see QR code ⇨)

Shoulder kinematics and muscle 'cost'[6] were compared across simulations

Selective capsulorrhaphy simulations were compared to a 'None' (i.e. no capsulorrhaphy) model to examine the potential relative effect of the surgical procedures

RESULTS

Shoulder joint kinematics and task performance time were unchanged

There were minimal differences between shoulder kinematics (i.e. < 2°) and task performance times (i.e. < 0.05 s) between the capsulorrhaphy models compared to the 'None' model.

Muscle 'cost' of movement increased with simulated selective capsulorrhaphy

Across all tasks on average, simulated capsulorrhaphy increased total muscle cost relative to the 'None' model. Total anterior, total inferior, total posterior and anteroinferior capsulorrhaphy models generated the greatest increase in muscle cost.

DISCUSSION

Elevated muscle 'cost' demonstrates an increased load on muscles that could lead to damage

Rehabilitation after surgical selective capsulorrhaphy is necessary to avoid joint damage, particularly for those who readily perform overhead shoulder movements (e.g. manual handling workers)

The prime movers at the shoulder drove the increase in muscle 'cost'

Our findings highlight the need to strengthen the major shoulder muscles (e.g. deltoid) with targeted rehabilitation following selective capsulorrhaphy

CONCLUSION

Shoulder kinematics and performance times did not change during upper limb movements under simulated glenohumeral capsulorrhaphy conditions

The elevated demand on muscles found highlights the need for targeted musculoskeletal rehabilitation following surgical glenohumeral capsulorrhaphy

Watch the Videos!

QR SCAN

Read the Paper[7]

REFERENCES

[1] Gerber et al. (2003), *J Bone Joint Surg Am*, 85: 48-55. **[2]** Brown et al. (2017), *Open Orthop J*, 11: 979-988. **[3]** Bankart (1938), *Br J Surg*, 26: 23-29. **[4]** Gates et al. (2012), *Am J Sports Med*, 40:2794-2800. **[5]** Dashottar et al. (2016), *J Orthop Sports Phys Ther*, 46: 1080-1085. **[6]** van der Krogt et al. (2012), *Gait Posture*, 36: 113-119. **[7]** Fox et al. (2021), *J Orthop Res*, 39: 880-890.