Centre for Doctoral Training in Tissue Engineering and Regenerative Medicine

Impingement risk in total hip replacement: effect of patient activity differences on recommended cup position

UNIVERSITY OF LEEDS

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Introduction

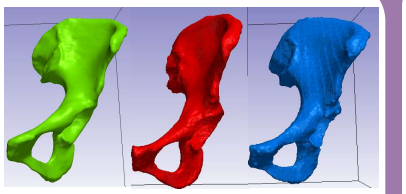
- Dislocation in total hip replacements is the highest cause of failure up to one year post surgery [1].
- Dislocation can be preceded by impingement, the unwanted contact between implant or bone which can cause a levering out of the femoral head [2].
- There are a number of factors which can cause impingement related to the patient, implant and surgical procedure [3].
- Currently, THR component placement targets are established in pre-operative planning using static assessment through either radiographs or 3D geometric modelling [4].

Study Aim

To investigate the influence of activity on impingement incidence when "impingement-prone activities" were applied to a 3D geometric model and the acetabular component position was varied.

Method

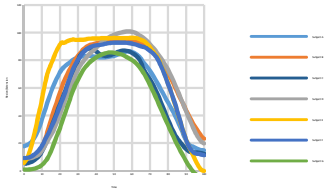
1. Nine computational geometric models were produced in SolidWorks from different CT scans and virtual THR components (DePuy Synthes) implanted.

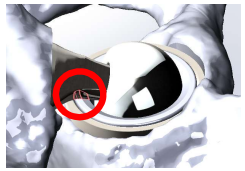


2. The geometric model which allowed the lowest range of motion before impingement was selected for this study.

3. Kinematic datasets (subject A to F) of six non-THR subjects carrying out eight impingement-prone activities were applied to the geometric model.

4. The cup orientation was varied between 30-50° radiographic inclination and 0-30° radiographic anteversion.





5. If there was contact between either the implant or the bone during the activity, then an impingement occurrence was recorded.

Results & Discussion

- A cup orientation grid was produced for each subject's kinematic dataset.
- Subject datasets resulted in different numbers of impingement occurrences at each acetabular cup orientation
- Subjects B and F represented the highest and lowest numbers of impingement occurrences.
- The recommended ideal cup position could be different for each subject.

Subject B		Inclination angle (°)				
		30	35	40	45	50
Anteversion angle (°)	0	6	6	6	4	4
	5	6	5	4	4	2
	10	5	3	2	1	0
	15	3	1	0	0	0
	20	1	0	0	0	0
	25	0	0	0	0	0
	30	0	0	0	0	0

Subject F		Inclination angle (°)				
		30	35	40	45	50
Anteversion angle (°)	0	0	0	0	0	0
	5	0	0	0	0	0
	10	0	0	0	0	0
	15	0	0	0	0	0
	20	0	0	0	0	0
	25	1	1	1	0	0
	30	1	1	1	1	1

Total number of impingement events	0	1	2	3	4	5	6	7	8
Grid annotation	0	1	2	3	4	5	6	7	8

- The extremes of joint angle for each subject could be the reason for the difference and could increase/decrease their likelihood of impingement.

Significance

- There was a difference in the area of the cup orientation grids which resulted in no impingement and therefore the area likely to be recommended as a cup orientation target for each subject.
- Patient activity data is not included in THR planning, the use of dynamic assessment could be a valuable tool during THR planning (there are some limitations to this).

DePuy Synthes

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References

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