KNEELING TASKS WITH AND WITHOUT KNEE PADS: REPEATABILITY AND LOADING VISUALISATION

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INTRODUCTION

Kneeling is an important activity of daily living. Trauma, degenerative conditions such as osteoarthritis, or the after-effects of local surgery may all lead to difficulty or the inability to kneel [1]. Anatomical structures contacting the ground change with varying kneeling postures [2]. Previous work [3] instrumented specific anatomical landmarks of the knee throughout kneeling tasks and presented the overall magnitude of applied loads. The aims of this work were to: (1) calculate the repeatability of left/right knee weight distribution; and (2) describe the loading distribution around the knee throughout various kneeling tasks. All kneeling tasks were performed with and without kneepads.

METHOD

Eight 12.7 mm diameter force sensitive resistors (FSRs) (Delsys, USA, 2000 Hz) were placed about the right knee (Figure 1) of 14 healthy participants (M/F: 7/7, age: 26.4 ± 2.5 years, height: 171.8 ± 4.9 cm, mass: 68.5 ± 12.8 kg). Vertical ground reaction force (F_z) data were captured using two in-ground force platforms (AMTI Optima, USA, 2000 Hz). Participants performed three trials of upright kneeling (60 secs) and reaching tasks: forward, back, left, and right (5 secs), with and without kneepads. Testing was repeated after a minimum three-day break. Matlab 2019b (MathWorks, USA) and R 4.0.3 (R Core Team, Austria) were used for data analysis. All participants provided written informed consent.

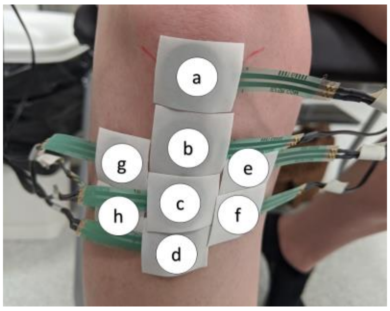

Figure 1: Four FSRs were placed in a line from (a) the inferior pole of the patella (IPP) to (d) the tibial tuberosity (TT); two FSRs were placed medially (e, f) and laterally (g, h) to this line, respectively.

RESULTS

The intra-class correlation coefficient (ICC(2,1)) of normalised F_z (BW) showed good (ICC = 0.6 – 0.74) to excellent (ICC = 0.75 – 1.0) [4] intersession repeatability between left/right knees for all kneeling tasks except for no pad upright kneeling on the left knee (ICC = 0.33), padded upright kneeling on the right knee (ICC = 0.38), padded right reaching on the left knee (ICC = 0.51). Bland-Altman analysis showed mean differences (BW) in left/right knees for all conditions between sessions lying within the 95% confidence intervals of the upper and lower limits of agreement.

Kneeling load distribution for all conditions are presented in Figure 2. The distal patella tendon (Figure 1c) was active for all kneeling conditions.

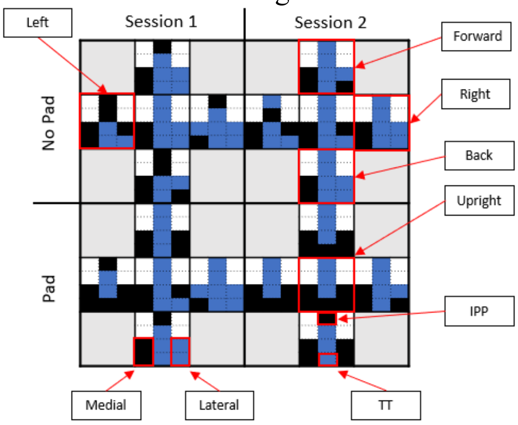

Figure 2: Heatmap representation of average FSR activation of the right knee during kneeling tasks as viewed from above. Black = no activation, blue = activation, white = no FSR placed.

CONCLUSIONS

We have demonstrated the repeatability of left/right knee weight distribution throughout various kneeling tasks and described the loading distribution of the right knee. Left/right knee weight distribution has shown to be reasonably reliable between sessions. Individual FSR activation of specific anatomical landmarks has shown to be an effective tool for visualising which structures are contacting the ground during kneeling. Fz data coupled with FSR activation provides valuable insights into both the magnitude and locations of applied loads throughout kneeling.

REFERENCES

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