



Shoulder Joint Position Sense – 3D assessment of laterality and impact of PNF vs Pure rotation movements with and without Tape

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Introduction

It is hypothesised that individuals with instability of the shoulder present with poor joint position sense and that rehabilitation (conservative and surgical) may improve this kinaesthetic dysfunction. Joint position testing of the shoulder however rarely involves open kinetic chain assessments. Furthermore, the movements are often set to the limitation of pure rotational patterns of movement.

In contrast most physiotherapists provide exercise prescription that involves diagonal and functional patterns of movement. It is hypothesised that the joint position sense performance will be better during PNF patterns when compared to pure rotation tasks. Another aspect of physiotherapy management is the use of “wind-up” shoulder taping to protect the shoulder during over head sports activities. It is unclear if taping changes the shoulder JPS performance in normal controls.

Purpose

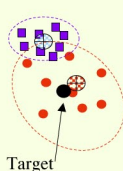
The purpose of this study was to examine if there are fundamental differences in joint position sense between sides in normal subjects and if testing in pure rotation differs with performance of position matching tasks using a diagonal pattern of movement. A second study examined if taping impacts on the performance of the repositioning task for accuracy or precision.

JPS – Reminder. There are two variables associated with rematching tasks.

Accuracy (●) the average error across multiple trials

Precision (---) Is the spread of the performance across trials

In rehabilitation Good Precision with Poor Accuracy ■ are easier to rehabilitate than Poor Precision and Good accuracy. ●



Methods

Open Kinetic 3D reposition sense testing was conducted in normal Male controls N=16 (Part 1 Left vs Right for three ranges) and N=12 (Part 2, Right arm comparing tape and no-tape) age 18 – 30yrs utilising virtual targets that lie along the normal movement trajectory of each individual. Three ranges were tested for both arms in a balanced randomised order for part 1 and 2 ranges for the taping study only for the right arm. Two movement patterns were tested. Pure (external) rotation with the arm in 90 abduction and the D2 PNF pattern – starting from the contralateral hip. The system was used in assessing spinal position sense and is described in (Allison et al Spine 2004)

Results Part 1.

There were no systematic trial effect (learning or fatigue) for the derivation of the error assessments. Part 1 used 10 matching trials but 5 or 6 were sufficient.

Symmetry

There were no statistical differences between sides (left and right) for movement pattern or range.

Range effect

For raw errors in 3D the statistical power did not detect difference between ranges or movement patterns. When controlled for length of trajectory, however % error D2 demonstrated greater accuracy for all ranges compared to rotation (p<0.05).

The % error, for the rotation movement only, had a range effect where the inner range was more accurate than the outer ranges.

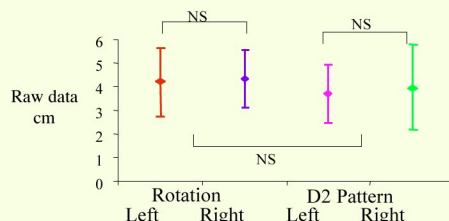


Figure 1. Raw data means and 95% CI for Movement pattern and sides. Pooled range data.

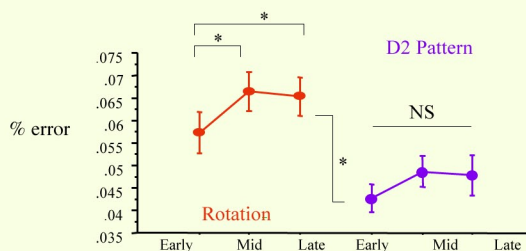


Figure 2. Trajectory normalised data (% error) means and 95% CI for Movement pattern and ranges. Pooled side data. Note: D2 more accurate than Rotation and range effect lost. ‘Late’ in range means abduction and external rotation.

Part 2 – The impact of taping

Range showed similar trends as in part 1 p = 0.0985 for both D2 and Rotation suggesting that a larger sample size would have detected a difference. Significant differences were not detected for the effect of tape however there was an indication that the precision improved when the wind-up tape came under tension (see Figure 3).

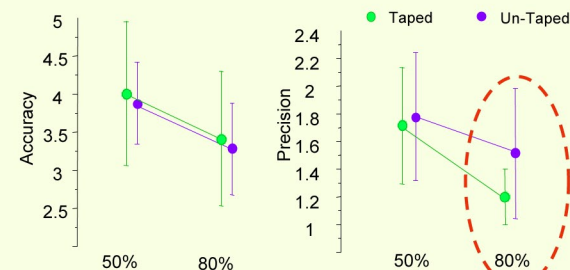


Figure 3 The impact of Taping on Shoulder Joint position sense. Note: a trend that the taping has an effect of improving Precision and that this is of most benefit at the end “wind-up” of range. This is a small effect size and more evident for D2.

Discussion.

In normal controls there is symmetry between sides for all the methods tested. This will confirm future research designs to allow within subject comparisons in individuals with unilateral anterior shoulder instability where the opposite side can be used as a control.

The large early range effect may be related to the length of the pathway that is performed to matched the target – the shorter the better – hence may not detect true JPS deficits. Despite the inner range changes, the mid and late range assessments are critical ranges for rehabilitation and stability training and are of future interest. The initial results suggest that PNF patterns are more accurate (when expressed as a % of movement) and have less range effects. The combined axial rotation of the limb segments may play an important role in this and supports the use of true PNF techniques and functional patterns.

The impact of taping seems to be consistent for both D2 and Rotation movement patterns. Both however “windup” the Gleno-Humeral capsule at the end of range.

The findings of this study show that in normal subjects the taping only met a statistical trend of improving the **precision** of the performance only at the end of range. This finding reflects the intended purpose of the ‘windup’ taping - to provide more consistency in the sensory feedback in the most vulnerable range of individuals with anterior instability.

Conclusions

This methodology allows 3D open kinetic chain assessment of shoulder position sense. The derive JPS variables are symmetrical in normal subjects and suggests a possible role for taping if a deficit is found in individuals with unilateral shoulder pathologies - instability. Future research will examine the pathological athletic population and determine if Taping has similar effects on accuracy and precision.