Pilot Data: Are vertical and lateral hop tests appropriate for patients post-ankle fracture?

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Background & Purpose

Ankle fractures effect 5 out of 10,000 individuals (van Staa, 2001). A recent study shows rapid functional gains over the first 6 months after an ankle fracture, but there are little or no gains 18-24 months into the recovery cycle (Beckenkamp, 2014). Similarly, other studies have shown that ankle fracture patients are categorized as having good recovery outcomes on popular measures such as the modified Olerud Molander scale (Egol, 2006), yet are unable to return to previous level of sport (Hong, 2013), indicating there may be persisting higher level performance deficits. This brings up the issue of whether there are performance based tests that would be appropriate for ankle fracture patients to determine return to sport or higher level activity without risk of injury. The purpose of this project is to determine the biomechanical load and side to side comparisons of vertical and lateral hopping tests that may be used in ankle fracture patients.

Hypotheses

1.) Frontal plane, rather than sagittal plane, kinetics will differentiate jumping tasks.
2.) There will be biomechanical symmetry between sides in the frontal and sagittal planes with jumping tasks.
3.) There will be symmetry between sides when clinically assessing jumping.

Subjects & Methods

Five control subjects, who met the inclusion and exclusion criteria, performed the following protocol made up of clinical tests and biomechanical analysis. Biomechanical analyses were completed with motion analysis cameras and force plate data collected. All jumps were completed starting from a squat position to reduce variability brought on by countermovement motions .

Clinical tests: two legged vertical jump, one legged vertical jumps, one legged repeated heel raises, wall dorsiflexion test, and a timed 30cm repeated lateral hop test performed double and single-legged.
Biomechanical tests: dorsiflexion, plantar flexion, eversion, and inversion ROM, one legged vertical hops, and one legged maximal medial and lateral hops with stable landing on one leg.

Results

Table 1.1 Clinical Test Data

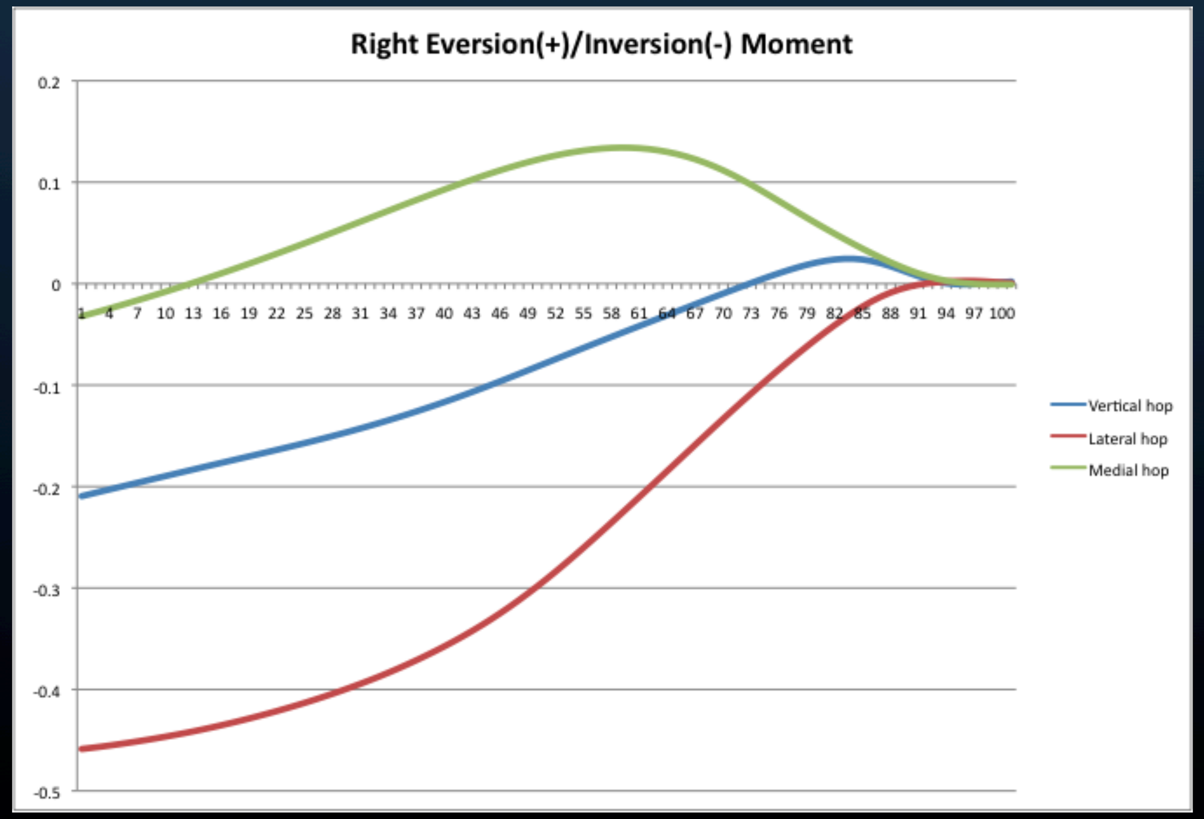
n=5	3 females 2 males	
	Average	SD
Age (yrs)	44.75	6.77
R DF wall test (cm)	12.1	4.72
L DF wall test (cm)	11.7	4.63
R Heel Raises (reps)	20.8	4.37
L Heel Raises (reps)	18	2.99
R Vertical Jump (cm/ height)	238.1	26.46
L Vertical Jump (cm/ height)	237.4	25.77
R 20x Lateral Hops (sec)	9	6.27
L 20x Lateral Hops (sec)	10.9	2.07

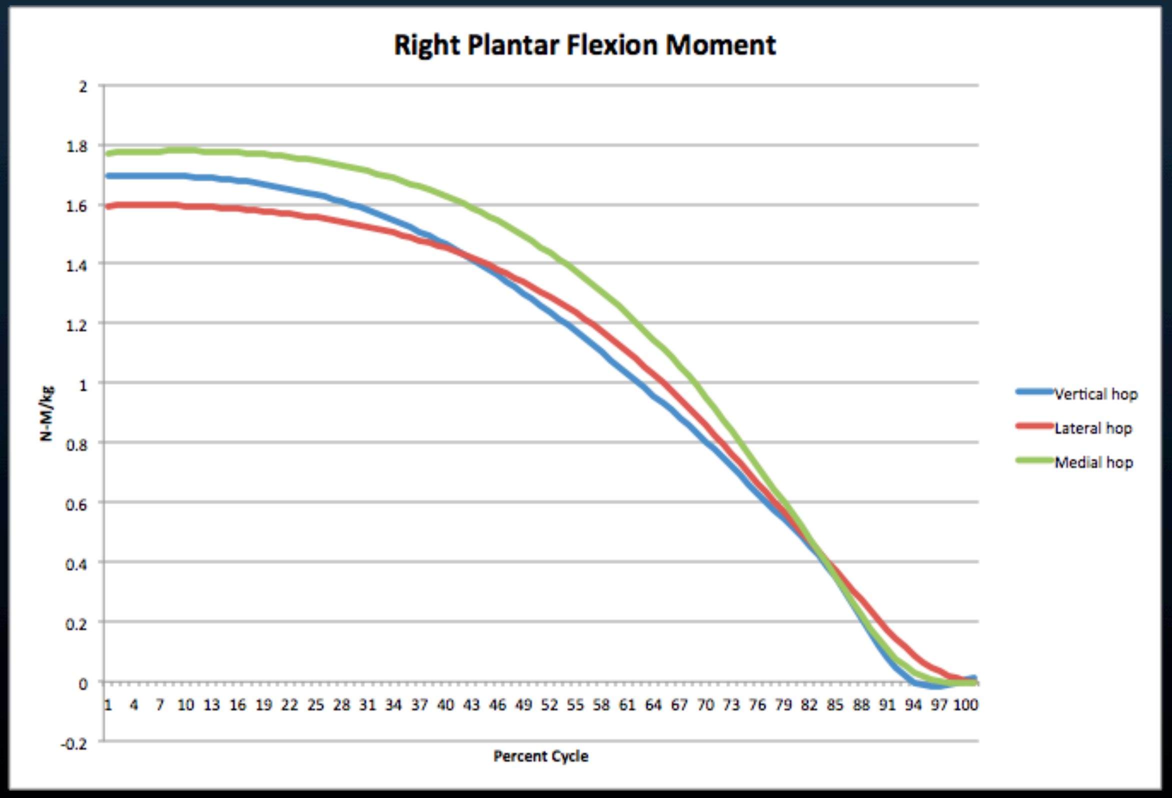
Table 1.2 Sagittal Biomechanical Data

	PF max Angle	Std ev	DF max Angle	Std ev	PF max Moment	Std ev	PF max Power	Std ev
R Vertical Hop	-38.4	3.9	18.7	2.6	1.8	0.3	11.5	2
L Vertical Hop	-37.8	4.5	17.5	2.9	1.9	0.1	12.9	2
R Lateral Hop	-28.1	10.8	17.1	2.9	1.7	0.2	9.2	1.2
L Lateral Hop	-26.5	12.2	16.9	2.7	1.8	0.2	11	3
R Medial Hop	-16.7	8.6	24.3	2.2	1.9	0.2	10.1	1.7
L Medial Hop	-17.2	7.2	22.8	1.8	2	0.2	11.3	2.5

Table 1.3 Frontal Biomechanical Data

	Ev max Angle	Std ev	Inv max Angle	Std ev	Inv Moment	Std ev	Ev Moment	Std ev
R Vertical Hop	-4.3	4.3	9.1	4	0	0	-0.4	0.2
L Vertical Hop	-8.8	4.1	8.3	3.9	0.1	0	-0.2	0.1
R Lateral Hop	-14.3	5.4	14	3.5	0	0	-0.7	0.2
L Lateral Hop	-18.5	4.3	11	3.4	0	0	-0.5	0.1
R Medial Hop	3.2	5.4	12.8	5.9	0.1	0.1	-0.2	0.2
L Medial Hop	0.3	5.1	10.1	3.1	0.2	0	0	0.1





Discussion & Conclusion

•Sagittal plane biomechanics was symmetrical for all jumping tasks; inversion and eversion was not as congruent between tasks.
•Power and moments are similar between jumps in the sagittal plane, but inversion and eversion ROM and moments vary greatly depending on the jumping task. Therefore, the frontal plane distinguishes each jumping motion.
•Jumping performance was symmetrical between right and left sides for each clinical test.
•In order to complete these tests, injured subjects must have almost twice than the normative range of motion associated with walking.
•Because frontal plane symmetry wasn't consistent, it may be necessary, in future studies, to do a sub-maximal hop to improve symmetry.
•Due to the large frontal plane ROM and moments associated with horizontal hops, the medial and lateral hops are most appropriate for determining eversion and inversion performance.
• For assessing the sagittal plane, using the vertical hop is most appropriate due to maximal power and plantarflexion ROM of all jumps.
•We don't know whether the medial or lateral hop will contribute to return to work/sport . The clinical relevance and evidence needs to be done to determine conclusion.

References

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