Kinetics and Kinematics after the Bridle Procedure for Treatment of Traumatic Foot Drop

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Summary:
This is the first study to report objective outcomes compared to normals for a modified posterior tibial tendon transfer (Bridle procedure) for treatment of foot drop resulting from peroneal nerve injury. This study demonstrated excellent return of swing phase ankle joint dorsiflexion but plantarflexor function during push off and hallux extension during swing were reduced in the Bridle group. A dynamic midfoot sag was noted during a heel rise task but no static arch collapse deformity was noted radiographically.

Introduction:
Traumatic foot drop from peroneal nerve injury is a devastating complication of trauma or surgery to the knee or hip. The Bridle procedure restores active ankle dorsiflexion through a tri-tendon anastamosis of the posterior tibialis, transferred to the dorsum of the foot, with the peroneus longus and anterior tibialis tendons. Inter-segmental foot motion after the Bridle procedure has not been measured. The purpose of this study is to report kinetic and kinematic variables during walking and heel rise in patients after the Bridle procedure. There are scattered clinical reports of the results of this procedure describing overall function and AFO use, but this is the first paper to evaluate the Bridle procedure using motion analysis and comparisons to controls.

Methods:
18 Bridle and 10 control subjects were studied at an interval of a minimum 1 year postoperative from the Bridle procedure (ave. 1.9 years post op) using an 8 camera 3D motion analysis system. Walking and heel rise kinetic and kinematic variables were collected and compared using an ANOVA. Attached Image Illustrates Bridle Procedure.

Results:
During walking the Bridle group, compared with controls, had reduced ankle power at push off (2.3 (SD=0.7) W/kg, 3.4 (SD=0.6) W/kg, respectively, P<0.01), less hallux extension during swing (-13° (SD=7), 15°(SD=6), respectively, P <0.01) and slightly less ankle dorsiflexion during swing (6° (SD=4), 9° (SD=2), respectively, P =0.03). During heel rise the Bridle group had 4° (SD=6) of forefoot on hindfoot dorsiflexion (ie dynamic midfoot sag)compared to 8° (SD=3) of plantarflexion in the controls (P <0.01).
Conclusion:
This study provides evidence that the Bridle procedure restores the majority of dorsiflexion during swing. However, plantarflexor function during push off and hallux extension during swing were reduced during walking in the Bridle group. Abnormal mid-tarsal joint motion, forefoot on hindfoot dorsiflexion instead of plantarflexion, was identified in the Bridle group during the more challenging heel rise task. This dynamic midfoot sag during heel rise was not evident in any static radiographic measures of arch collapse. Post operative management therapy after the Bridle procedure must maximize ankle plantarflexor function and midfoot motion should be examined during challenging tasks. A focused physical therapy program and an arch supporting foot orthosis may help improve long term function. Further study is needed to determine if modifications to the surgical procedure or limiting the use of a gastrocsoleus lengthening procedure (which may further weaken push off) are additional considerations that might improve function following this procedure.