``In vitro analysis of stabilization forces applied through a dynamic spring ACL brace compared to a static one, examined through a range of knee tests

Buchman A[1] Kazakevich E[1], Greenberg S[2], Gottlieb R[2], Gabay T[1].

1.Department of Biomedical Engineering, Tel Aviv University, Tel Aviv Israel

2. The Academic College Levinsky-Wingate (Wingate Campus) Netanya Israel

ABSTRACT

Background: Anterior circuit ligament (ACL) tears are one of the most serious injuries in sport, yet regular bracing may not reduce risk of injury.

Aim: Comparing the stabilization forces applied to knee joint between a novel dynamic spring ACL brace and a traditional static one.

Methods: Nine healthy males (mean age=23.4±3.4yrs; height=1.8±0.3m; body-mass= 81.1±6.3kg) underwent two sets of seven tests, once wearing the dynamic brace and once with a traditional one. Tests included Lachman (LT); pivot shift test (PST); single-leg squat (SLS), Thessaly (TT); drop jump (DJ), crossover hop test (CH); and 90° rotational hop (RH). During all tests, force measurement sensors were placed under the brace: three under the upper femoral strap and three under the lower tibia strap. Measurements included peak changes in stabilization forces (total and posterior), high-risk joint-rotation (HRR) and low-risk joint-rotation (LRR), and time-to-peak force.

Results: Total peak force was significantly higher in the dynamic brace (LT=69±5, PVT=154±8; SLS=140±8; TT=138±6; DJ=120+5; CH=136±8; and RH=128±4 g/cm; and LT=15±3; PVT51±7; SLS14±2; TT =13+4; DJ18±4; CO=15±3; and RH16±3 g/cm, respectively, $p<0.001$). This mainly resulted from the significantly higher

posterior forces seen in the dynamic brace than in the static one (LT=31+4g/cm; PS=30+2g/cm; SLS=65+6g/cm; TT=52+3; DJ=55+5; CH=50+4; RH=67+5g/cm; and LT=4.7+2; PS=5+3; SLS=3+1.8; TT=8+3; DJ=5+3; CH=7+3g/cm, respectively, P<.001) Additionally, in some tests, the time-to-peak in HRR stabilization forces was significantly higher in the novel dynamic brace than in the static one (PS=82+5; TT=44+3; DJ=39+5; CH=57+3; RH=50+6g/cm; and PS=30+3; TT=4+1; DJ=6+3; CH=3+1; RH=4+2g/cm, respectively, P<.001). Moreover, when examining the type of test, time-to-peak pressure was significantly shorter in the dynamic spring brace than in the static one for three functional tests (DJ=330+6; CH=26O+5; RH=290+5mil/sec) compared to the standing SLS test (77O+8mil/sec, $p<0.01$); similar findings were seen for the HRR (CH=170+3; RH=130+3ml/sec) compared to the standing TT (550+5ml/sec) and to the passive PVT (800 ml/sec), $p<0.01$.

Conclusions: These finding demonstrate that the novel dynamic ACL brace presented in this research provides between stabilization forces than traditional static one, which could be beneficial in preventing ACL injuries in athletes.