Practical solutions to Submaximal Nordics: insights for exercise familiarization and return to train following knee flexors injury.

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Hamstrings | Assesment | Strength | Rehabilitation

Headline

The Nordic exercise is probably the most controversial exercise when it comes to training and testing knee flexors (1). Among the various reasons for some practitioners to dislike the Nordic exercise, the close-to-maximal intensity of the exercise is often advanced as a major limitation. In fact, the exercise requires high levels of strength to be performed correctly (i.e., to manage to control the descent over the full range of knee extension). The existence of this so-called breaking point (2) during the descent likely prevents the strengthening of the knee flexors over their full range of motion (i.e., toward full knee extension), where it may be in fact the most beneficial in relation to injuries (3). Also, weak and/or unfamiliarized athletes also often report uncomfortable sensations during the exercise in relation to the high muscle tension. Finally, because of the high levels of strength required to perform the exercise, the use of Nordics is also generally restricted to the last phases of rehabilitation, which prevent both a progressive loading and a continuous monitoring of athletes' knee flexors strength with the same exercise. For all the abovementioned reasons, practical means that could allow athletes to perform submaximal Nordics (4, link) would likely increase its player and staff buy-in, helping movement familiarization and its integration at earlier stages during the return from injuries process.

Aim

The aim of the present study was to 1) (re)examine the feasibility of reducing Nordics intensity using elastic bands (4) and 2) quantify the magnitude of Force reduction in relation to band number and player's body mass.

Methods

A group of 15 individuals (a mix of professional players and staff (85 ± 10 kg)) from an elite soccer club performed 3 series of 2 reps of the Nordic exercise on a Nordbord (Vald Performance, Newstead, Queensland, Australia) using either 2 bands (Black Roll Resist Band, Grey band, Black Roll, Bottighofen, Switzerland), 1 band or none in a randomized order. The band resistance is directly related to the stretch, with the resistance ranging from 40 to 80 kg when the band stretches from 20 to 80% of its initial length (Black Roll unpublished information). Players were requested to hold maximally their descend and complete the overall movement within approx. 10 s. The overall set up is shown in Figure 1. The distance between the Nordbord and the wall ladder was 15 cm. The bands were attached on the top of the wall ladder (2.35 m from the ground). All participants performed a standardized warm-up including 5 min of cycling at low intensity and dynamic movements involving the posterior chain at high amplitude (lunge, full body squat and front kicks). Given the very large relationship between Nordbord performance and body mass (BM), Force data (both legs pooled) were allometrically scaled based on the current sample distribution. The regression equation of the Log-Log relationship was y = 1.34 x + 0.0162, with $r^2 = 0.65$, so the exponent used was 1.34 (5). We first looked at the percentage of Force reduction as a function of the number of bands used. Possible correlation between 1)

Fig. 1. A soccer player performing the Nordic exercise with 1 band.

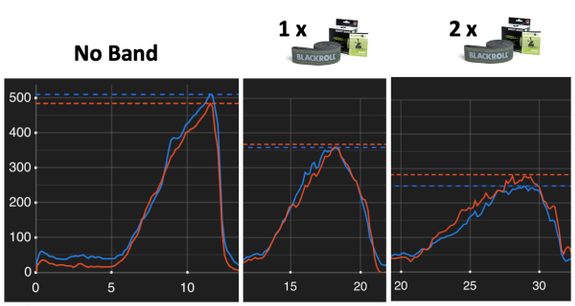

Fig. 2. Individual Force traces during the Nordic exercise when using no band, 1 or 2 bands for an individual player (85 kg). Unit on the Y axis is N.

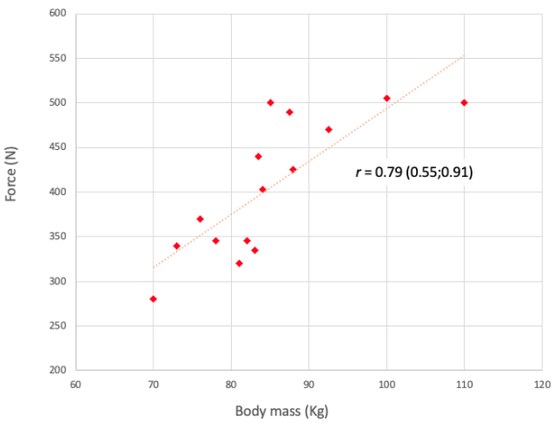

Fig. 3. Relationship between Nordbord Performance without bands and body mass, suggesting the need for allomeric scalling to adjust for the likely effect of body mass on performance. n = 15. See methods for details about the scalling procedure.

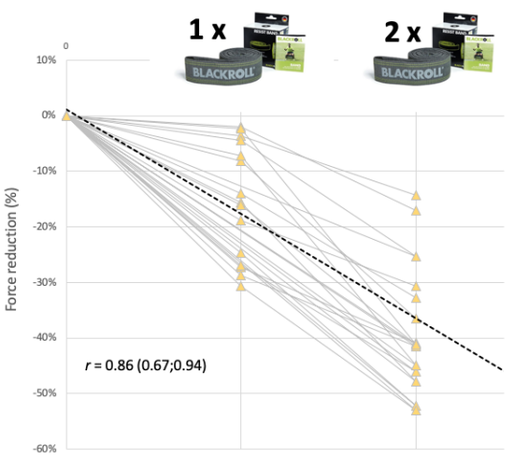

Fig. 4. Individual reduction (%) in Force applied to the Nordbord sensors when using 1 or 2 bands. n = 15.

the % of Force reduction and BM, 2) the % of Force reduction and the band resistance in relation to BM and 3) the % of Force reduction and scaled Nordbord performance were also examined.

Results

Figure 2 shows the typical Norbord Force measure during the Nordic exercise while using no band, 1 or 2 bands in a representative player. The very large relationship between Nordbord performance and body mass is shown in Figure 3. Figure 4 shows the individual % reduction of Force applied to the Force cells as a function of the number of bands. In average, the reduction was -15 ± 10 % and -40 ± 10 % for 1 and 2 bands, respectively. The % of Force reduction was not correlated with body mass (Figure 5). Finally, there were large negative correlations between the % of Force reduction and scaled Nordbord performance (Figure 6).

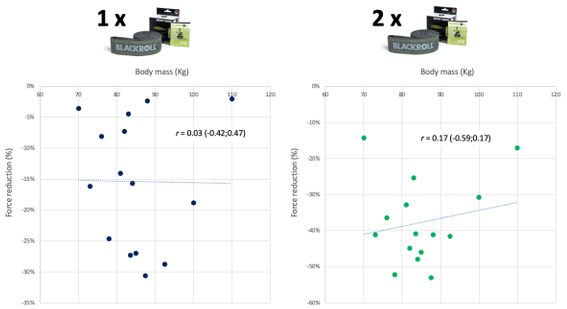

Fig. 5. Relationship between reduction in the Force applied to the Nordbord sensors (%) when using 1 or 2 bands and body mass. n = 15.

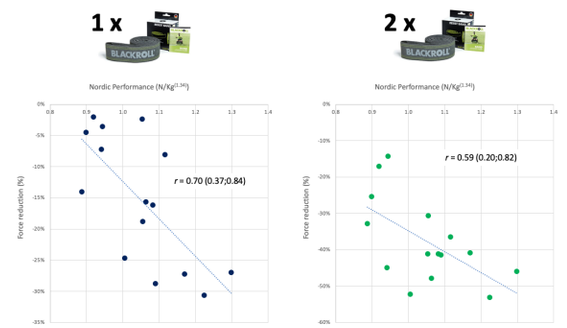

Fig. 6. Relationship between reduction in the Force applied to the Nordbord sensors (%) when using 1 or 2 bands and scaled Nordbord performance. n = 15.

Discussion

We used here for first the time the changes in Nordbord performance in response to the use of commercially available bands to assess practical means to alter Nordic exercise intensity. Our results show that within our specific setting (Figure 1), Nordic intensity can be reduced by 15 to 40 % using 1 and 2 bands, respectively (Figure 4). It is important to note that the present results are specific to the present set up (type of bands, placement and angle of the bands in relation to the body, etc.) and can't be directly extrapolated to other contexts. We believe however that the overall approach is worth sharing for practitioners who may be able to develop their own protocols within their own context using their own materials.

Surprisingly, the results showed that body mass (Figure 5) had no impact on the % of Force reduction. While this may be counterintuitive a priori (i.e., the heavier the player, the lower the band effect), this confirms that other factors may explain both the Nordbord performance (3, 6, 7) and the magnitude of reduction in Force with bands. Among those, the ability to perform the movement over the full range of motion (or not) is probably the most important. While behind the scope of the present study, the break-point angle that is well related to overall knee flexor strength and Nordic performance (2) may need to be considered to explain this point. In fact, Figure 6 shows an inverse relationship between performance reduction with bands (i.e., the greater the player's strength, the greater the effect of the band(s)) and body-mass adjusted Nordbord performance.

This could be interpreted as the following: in comparison to their performance with the bands where they could likely complete the movement over the full range of motion (lower load, no breaking-point), without bands (full body mass engaged) the weakest individual may not be able to control the eccentric movement until the last degrees of knee extension (presence of a breaking-point), leading to a lack of performance improvement despite their greater overall "mass" (5). Examining Force patterns in relation to motion characteristics (e.g., existence of a breaking point, knee angle of peak torque...) should therefore be the focus of future studies to clarify this latter hypothesis.

Key points

- The Nordic exercise is controversial for many reasons – one of them is related to the fact that it is an intense exercise especially for weak players and/or those not familiarized with it, who can't perform the full movement (full extension of the knees).
- We showed here that using simple commercially available bands can help reduce the intensity by 15 (1 band) to 40 (2 bands) %.
- Using bands may therefore be more effective than the traditional version, at least until players build up enough strength to sufficiently control their body mass during the eccentric phase without the use of bands (4) (e.g., early stages of rehabilitation following knee flexors injury).
- Whether submaximal Nordics performed over the complete range of motion have a greater potential for fascicle length improvements (3, 8) in weak players and/or those showing a clear breaking point still needs to be examined.
- The large inter-individual differences in the response to the use of the bands are unlikely related to athletes' body mass but more likely to their typical (no band) Nordbord performance, with 1) the weakest benefiting more from the band assistance toward the full range of motion and 2) the strongest showing a greater reduction in performance with bands.

Acknowledgement

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References

1. Buchheit, M., et al., Injury rate and prevention in elite football: let us first search within our own hearts. Br J Sports Med, 2018.
2. Sconce, E., et al., The validity of the nordic hamstring lower for a field-based assessment of eccentric hamstring strength. J Sport Rehabil, 2015. 24(1): p. 13-20.
3. Bourne, M.N., et al., An Evidence-Based Framework for Strengthening Exercises to Prevent Hamstring Injury. Sports Med, 2018. 48(2): p. 251-267.
4. Contreras, B., The Nordic Ham Curl: A Staple Exercise for Athletes. https://bretcontreras.com/nordic-ham-curl-staple-exercise-athletes/. Bretcontreras.com, 2014(December, 16th).
5. Buchheit, M., et al., The Effect of Body Mass on Eccentric Knee-Flexor Strength Assessed With an Instrumented Nordic Hamstring Device (Nordbord) in Football Players. Int J Sports Physiol Perform, 2016. 11(6): p. 721-726.
6. Buchheit, M., et al., The quadrant of doom and hamstring injuries: sexy but too easy? Sport Performance & Science Reports, 2019. July(63): p. V1.
7. Roe, M., et al., Eccentric knee flexor strength profiles of 341 elite male academy and senior Gaelic football players: Do body mass and previous hamstring injury impact performance? Phys Ther Sport, 2018.
8. Lacome, M., et al., Knee-flexor eccentric training: Does training volume really matter? Int J Sports Physiol Perform, 2019: p. Apr 29:1-27. doi: 10.1123/ijspp.2018-0947. [Epub ahead of print].