USE OF WEARABLE ELECTROMYOGRAPHY IN REHABILITATION PROCESSES FROM MUSCLE INJURIES

Gasol-Santa X[1], Turmo-Garuz A[1, 2, 3], Díaz-Cueli D[1], Ruzza M[3], Hoffren-Mikkola M[4]
[1]RCD Espanyol of Barcelona, Spain; [2]High Performance Center of Sant Cugat, Consorci Sanitari de Terrassa, Sant Cugat, Spain; [3]Professional Sports Medicine School, University of Barcelona, Spain; [4]Kuortane Olympic Training Center, Kuortane, Finland

Introduction

Due to huge burden caused by injuries and rehabilitation processes to professional football clubs, there is an increasing interest for objective monitoring of functional rehabilitation processes from muscle injuries. On the other side, there is an increasing development of wearable devices that are easy-to-use in many sport conditions. Time to return to play from injuries is critical and correct decisions about player's condition should be made in tight schedule. Unfortunately, the re-injury rate is high which highlights that additional methods to evaluate player's physical condition more precisely should be sought. Knapik et al. (1) reported a higher risk of injury in athletes with imbalances in knee flexor strength or hip flexibility greater than 15% between the right and left sides. With modern wearable electromyography (EMG) devices it is possible to monitor muscle imbalances in both laboratory as well as in field conditions including fast exercises that may better represent the real training and game conditions and requirements. This information may help football club professionals in decision making during functional rehabilitation processes and possibly therefore decrease and avoid further injuries. The objective of this study was to determine the use and importance of surface EMG (sEMG) data from wearable devices on decision making process during rehabilitation processes and return to play.

Methods

Subjects of the study were one elite goalkeeper and one elite midfielder of La Liga (Spain) aged 21 (193 cm, 91 kg) and 28 (174 cm, 72 kg) years, respectively, who had suffered grade II hamstring injuries affecting conjoint tendon. The goalkeeper's injury was located 12 cm from ischiatic tuberosity and was 5 cm long, without objective gap on muscle fibers. The midfielder's injury was located 9,5 cm from ischiatic tuberosity and was 4,5x2 cm in dimension involving muscle fibers of biceps femoris. In both cases diagnosis was made by ultrasound scan and magnetic resonance imaging two days after injury. According to Munich consensus of muscle injuries both of them were 3A type injuries (2).

Myontec's MBody Pro (Myontec Ltd, Kuopio, Finland) was used to monitor hamstring and quadriceps muscle groups sEMG in different gym and field exercises during the functional rehabilitation processes. The method has been validated against traditional sEMG and has been shown to be a reliable tool to assess EMG both in static and dynamic exercises (3). A follow-up evaluation was made based on isometric wall squats (IWS) of 45 s of work and 15 s rest as well as four sets of 50 meters running at constant speeds (12 and 18 km/h) (Run12 and Run18, respectively). Tests were performed once a week.

Results

Results showed muscle activation asymmetries between injured and non-injured legs at various phases of rehabilitation processes. Asymmetries were reduced to the final phases of rehabilitation. Table 1 shows the relative sEMG in injured and uninjured leg for running and isometric wall squats at different measurement time points.

TABLE 1. Difference between injured and uninjured leg sEMG during various phases of rehabilitation process.

			Quadriceps			Hamstring		
Player	**weeks**	**Exercise**	**%EMG injured leg**	**%EMG uninjured leg**	**% diff.**	**%EMG injured leg**	**%EMG uninjured leg**	**% diff.**
Goalkeeper	2	IWS	43,9	56,1	21,2	43,0	57,0	24,5
Goalkeeper	3	IWS	49,5	50,5	2,0	47,1	52,9	11,0
Goalkeeper	4	IWS	47,6	52,4	9,2	34,5	65,5	47,3
Midfielder	2	IWS	40,9	60,0	33,2	36,3	63,7	43
Midfielder	3	IWS	39,8	60,2	33,8	49,6	50,4	1,6
Midfielder	4	IWS	46,6	53,4	12,7	54	46	-14,8
Goalkeeper	3	Run12	44,1	55,9	21,1	32,8	67,2	51,2
Goalkeeper	4	Run12	44,3	55,7	20,5	41,6	58,4	28,8
Midfielder	2	Run18	41,4	58,6	29,6	37,7	62,3	39,5
Midfielder	3	Run18	60,8	39,2	-35,5	47,8	52,2	8,4
Midfielder	4	Run18	51,8	48,2	-6,9	51,1	49,9	-2,3

Conclusions

Clinical interpretation of sEMG data may be useful in monitoring the course of the injury. sEMG registered in fatigue could help to show up asymmetries that could be otherwise undetectable in last stage of the rehabilitation process.

References

1. Knapik JJ, Bauman CL, Jones BH, Harris JM, Vaughan L. Preseason strength and flexibility imbalances associated with athletic injuries in female collegiate athletes. Am J Sports Med 1991; 19: 76-81.
2. Mueller-Wohlfahrt HW, Haensel L, Mithoefer K, Ekstrand J, English B, McNally S et al. Terminology and classification of muscle injuries in sport: the Munich consensus statement. Br J Sports Med 2013; 46:342-350
3. Finni T, Hu M, Kettunen P, Vilavuo T & Cheng S. (2007). Measurement of EMG activity with textile electrodes embedded into clothing. Physiol Meas 28 (11): 1405-19.