

Cumulated injuries in junior female figure skater caused by detraining in COVID-19 lockdown

Tena Šimunjak¹, Sanda Dubravčić-Šimunjak², Petra Hodak³, Sarah Filipović⁴, Katarina Ivanković², Boris Šimunjak¹

¹ Department of Otorhinolaryngology, Head and Neck surgery, University Hospital "Sveti Duh", Zagreb, Croatia

² Department of Physical Medicine and Rehabilitation, University Hospital "Sveti Duh", Zagreb, Croatia

³ Health Center Zagreb, Family Practice, Zagreb, Croatia

⁴ Department of Radiology, University Hospital "Sveti Duh"

ABSTRACT:

As the SARS-CoV-2 virus started its fulminate spread, due to strict epidemiological measures, athletes were transferred to unsupervised online training. This resulted in injury increase occurrence in elite sport. Some of many reasons for this are detraining process linked with reversible decrease in muscle mass and increase in body fat content.

We present the unique case of the 13-year-old healthy, junior female figure skater who suffered from multiple injuries associated with unsupervised training and detraining during COVID-19 lockdown. This case reports injuries described in elite athletes' population, but never reported cumulatively in three months' time period. Healthy elite athlete with magnetic resonance imaging was diagnosed with a stress fracture of the second and stress reaction of the fourth metatarsal bone, which occurred during online unsupervised training. The same patient also suffered from lumbar disc protrusion on L4-L5 segment and disc bulging sign on L3-L4 and L5-S1 segments, which occurred after lockdown period, in immediate return to sport. Individual rehabilitation program, which included different modalities of physical therapy during which special attention was given to strengthening, stretching, proprioceptive and dynamic neuromuscular stabilization exercises, resulted in safe and pain free return to sport.

A multi-faced controlled exercise program should be considered as part of successful rehabilitation program in elite sport. As part of injury prevention program, we suggest that sporting federations in collaboration with medical and sport experts develop and implement different and convenient sport-specific guidelines to prevent a rapid increase of injuries in different sport disciplines.

KEYWORDS: COVID-19, detraining, sports injuries, rehabilitation, figure skating

SAŽETAK:

KUMULIRANE OZLJEDE U JUNIORSKE UMJETNIČKE KLIZAČICE USLIJED PROCESA DETRENIRANOSTI TIJEKOM COVID-19 LOCKDOWN-A

Kako se SARS-CoV-2 virus ekspanzionalno počeo širiti svijetom, sportaši su, zbog strogih epidemioloških mjera, bili preusmjereni na tzv. online treninge bez odgovarajućeg nadzora. To je rezultiralo porastom broja ozljeda u vrhunskom sportu. Jedan od mogućih uzroka tih ozljeda povezan je s procesom detreniranosti, koji dovodi do reverzibilnog smanjenja mišićne mase i povećanja količine masnog tkiva.

U radu je prikazan jedinstveni slučaj 13-godišnje zdrave, juniorske umjetničke klizačice čije su višestruke ozljede povezane s treningom bez nadzora i procesom detreniranosti tijekom COVID-19 lockdowna. Iako su nastale ozljede opisane u populaciji vrhunskih sportaša, njihov kumulativni broj,

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Correspondence:

Tena Šimunjak
tena.simunjak1904@gmail.com

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u jednoga sportaša, u razdoblju od tri mjeseca, do sada nije zabilježen. Zdravoj juniorskoj sportašici magnetskom rezonancom dijagnosticirana je stress fraktura četvrte i stress reakcija druge metatarzalne kosti istoga stopala, nastale tijekom online treninga bez nadzora. Nakon lockdowna, po povratku na redovne treninge, kod iste je sportašice verificirana dijagnoza protruzije intervertebralnog diska na L4-5 segmentu te bulging diska na L3-4 i L5-S1 segmentu lumbalne kralježnice. Individualni program rehabilitacije uključivao je različite modalitete fizikalne terapije tijekom kojih se posebna pozornost pridavala vježbama snaženja, istezanja, proprioceptije te dinamičke neuromišićne stabilizacije, što je rezultiralo sigurnom i bezbolnom povratku sportu.

Kontrolirani i individualno prilagođeni programi vježbanja trebali bi biti sastavni dio uspješnog rehabilitacijskog programa u vrhunskom sportu. Kao dio programa prevencije ozljeda, predlažemo da sportski savezi u suradnji s medicinskim i sportskim stručnjacima razviju i provedu različite sportu specifične smjernice treniranja sportaša.

KLJUČNE RIJEČI: COVID-19, detreniranost, sportske ozljede, rehabilitacija, umjetničko klizanje

INTRODUCTION

Global pandemic stroked the world in 2020. caused by the severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2 or COVID-19). Numerous precaution actions had to be taken to prevent the rapid spread of the disease including strict lockdowns. Elite sport was also highly affected by SARS-CoV-2: championships have been cancelled, important international sport events, like Summer Olympic Games and European Football Championships have been postponed and athletes were obliged to train on their own, often in their homes without appropriate training conditions and frequently unsupervised (1). For athletes, lockdown and COVID-19 pandemic poses an uncertainty in regularly training and competition regime. In addition, little is known about how long would it all last and how much it will affect the sport in the future. Sudden cessations and sudden returns to regular training, as well as trainings becoming quite unorganized, with uncoordinated increase in intensity and effort may lead to an increased risk of injuries.

Based on our knowledge, this case report is the first and unique case of healthy junior female figure skater, who suffered from multiple injuries that occurred during online home training in lockdown and immediately after return to on-ice sport activities and training. This case reports injuries described in elite athletes' population, but never reported cumulatively in very short period of time. In only three months' time period the junior healthy athlete was diagnosed off stress fracture that co-occurred with stress reaction on the same foot, followed by lumbar disc protrusion and disc bulging signs.

CASE REPORT

We present a case of the 13-year-old junior female figure skater, which in presents of her parent signed informed consent form for images and other clinical information related to her case to be used for medical publication. The patient sustained second

metatarsal bone stress fracture that co-occurred with fourth metatarsal bone stress reaction during lockdown period, when all ice-skating rinks were closed and all skaters were forced to do online training created by their coach with guidelines from International Skating Union experts. The same patient also suffered from lumbar disc protrusions on L4-L5 segment and disc bulging sign on L3-L4 and L5-S1 segments, which occurred in immediate return to sport after lockdown online unsupervised training. The patient's condition started with gradual onset of pain on her landing foot during online rotational training. Once the pain was present not only during training, but also during daily activities the patient was examined by the orthopaedic surgeon who prescribed magnetic resonance imaging (MRI) of her foot. MRI scan showed stress fracture of the second (Figure 1) and stress reactions of the fourth metatarsal bone (Figure 2), due to which Walker stabilizing orthosis and unloaded walking with crutches for six weeks were prescribed. On the first physical examination, besides pain in her foot and positive one leg hop-test, the 13-year-old skater presented normal posture and spinal mobility. Hamstrings muscles flexibility was reduced. Patient was treated with different modalities of physical therapy for two months including pulsed magnetotherapy, laser therapy and different type of exercises for stabilization, mobilization, stretching, strengthening and proprioception, with suppression for further online off-ice training.

During summertime, end of July 2020, the skater went three weeks to summer training camp, after being off the ice for four months. She returned to physician office with excessive back pain, which dominated in distal lumbar region. Paralumbar muscles were painful and tense with restricted range of motion (ROM), especially in sagittal plane. Tests for overuse injuries of iliopsoas and piriformis muscles were negative. MRI scan of the lumbar spine was conducted immediately and showed imposing



Figure 1. Left foot MRI scan showing stress fracture of the second metatarsal bone



Figure 2. Left foot MRI scan showing stress reaction of the fourth metatarsal bone

finding for 13-year-old athlete, with no previous medical history of spinal injuries – disc protrusion at L4-5 lumbar segment gathered with disc bulging signs at L3-4 and L5-S1 segments (Figure 3). Since beginning of September 2020 till beginning of January 2021 the patient has undergone different modalities of physical therapy with special attention given to dynamic neuromuscular stabilization program, stretching and proprioceptive exercises, biofeedback training along with pulsed magnetotherapy, laser therapy and Winback Tecartherapy. All other unsupervised training programs were forbidden. The ROM and core stability in her lumbar segment increased, hamstrings muscles flexibility increased and pain in lumbar region decreased. The athlete was back on gradual training regime with adequate stretching, warm-up and cool-down activities before/after the training session in October of 2020. After finishing the supervised rehabilitation program, the skater was pain free and was able to train all difficult skating elements that impose excessive stress on core and lumbar spine region.

DISCUSSION

During the lockdown period, most of the athletes trained alone and unsupervised. This kind of training posed certain risks for athletes' injuries, including poor training techniques and involuntary omission in posture alignment (2). Unsupervised training and isolation can anticipate to inappropriate and poor nutrition with decrease in muscle mass and increase in body fat content, compromised immunity, poor quality of sleep, insufficient communication between athletes and coaches and detraining (3-5). Detraining is the principle of training reversibility which declares that discontinuance and reduction in training routine generates a partial or complete reversible process of previously developed muscle alteration, jeopardizing athletes' performance (6). Detraining throughout 2-4 weeks provoke physiological changes in muscle capillarization and deprivation of the body temperature regulation mechanisms. When detraining last longer than four weeks, a decrease in arterial-venous oxygen difference is detected, which result in reduction of maximal oxygen delivery to the skeletal muscles. If this period lasts longer than one month, the oxidative enzyme activity in skeletal muscle is diminished (6). Short-term detraining process affects eccentric strength and the size of the Type II (FT: fast-twitch) muscle fibers. Transition from Type II fibers into Type I (ST: slow-twitch) fibers is identified when inactivity exceeds 4 weeks, especially in sports categorized by explosive activities, as FT muscle fibers are more vulnerable to inactivity than the ST fibers (4). Physiological studies conducted on muscle and tendon fibers adaptational process showed that changes in muscle size and architecture occur after short-term off-loading. The rate of muscle tissue atrophy and muscle loss is greater and more accelerated in well-trained elite athletes with imposing initial muscle mass than in recreational athletes or non-trained population (2).

A cross-sectional study conducted by Pillay et al. (2) included 692 elite and semi-elite athletes from 15 sports showed that only 50% of questioned athletes were comfortable with return to sport after lockdown period, when allowed by authorities. Same study showed that half of the athletes during lockdown period trained at inferior exercise intensity and level than usual. In addition, sleep patterns changed significantly, during leisure time a significant number of athletes preferred inactive above active manners, 52% of athletes felt depressed, and 55% required additional motivation to keep active. A significant number of athletes consumed excessive amounts of carbohydrates. Only a small number of athletes included proprioceptive exercises in their training routine, which, as described in literatures, plays an essential role in injury prevention programs (3).

Another study by Fikenzer et al (7) reported that the COVID-19 lockdown, in elite handball players, despite home-based strengthening and endurance training, without team training, resulted in diminution of muscle endurance capacity.

Matheson et al (8) indicated that only 9% of evaluated 320 stress fractures occurred on metatarsal bones in their stress fracture study among athletes, conducted during 4 years' time. The female athlete's triad, as part of RED-S (relative energy deficiency in sport) emphasizes the predisposition of immature female athletes to stress fractures (9,10). A stress fracture represents an overuse injury which occurs due to recurrent microtrauma that overcomes the tissue reparation potentiality. Temporary bone reduction is result of accelerated bony remodeling process during which osteoclastic activity surpasses the ratio of osteoblastic new bone formation. For additional bone reinforcement the new periosteal bone is developed, but the full cortical fracture may occur if the ongoing osteoclastic activity exceeds the proportion of osteoblastic new bone formation (9). Numerous studies show that different alterations in the training regime pose the most important risk factor in the overuse injuries occurrence (11-13). We can inevitably define, in the sports aspect, COVID-19 lockdown as a form of rapid change and alteration in the training program, which poses risk for overuse injuries as seen in our case patient. Overuse injury prevention program should include exact and convenient general and sport-specific guidelines for unsupervised training, especially in sports where uncontrolled jumps and rotational exercises may lead to injuries (14, 15).

Symptomatic disc herniation develops from the rupture of the intervertebral disc and gel-like nucleus pulposus extravagating the injured annulus fibrosus and compressing a spinal nerve. Acute injury mechanism of flexion and compression or rotational motion can cause the spinal disc protrusion (16). Lumbar spine problems among aesthetic sports are related to repetitive arching movements that require hyperextension of the spine. Training errors with inadequate flexibility and premature progression to higher risk skills can cause the lumbar spine dysfunction, as seen in our patient with lumbar disc protrusion and bulging signs

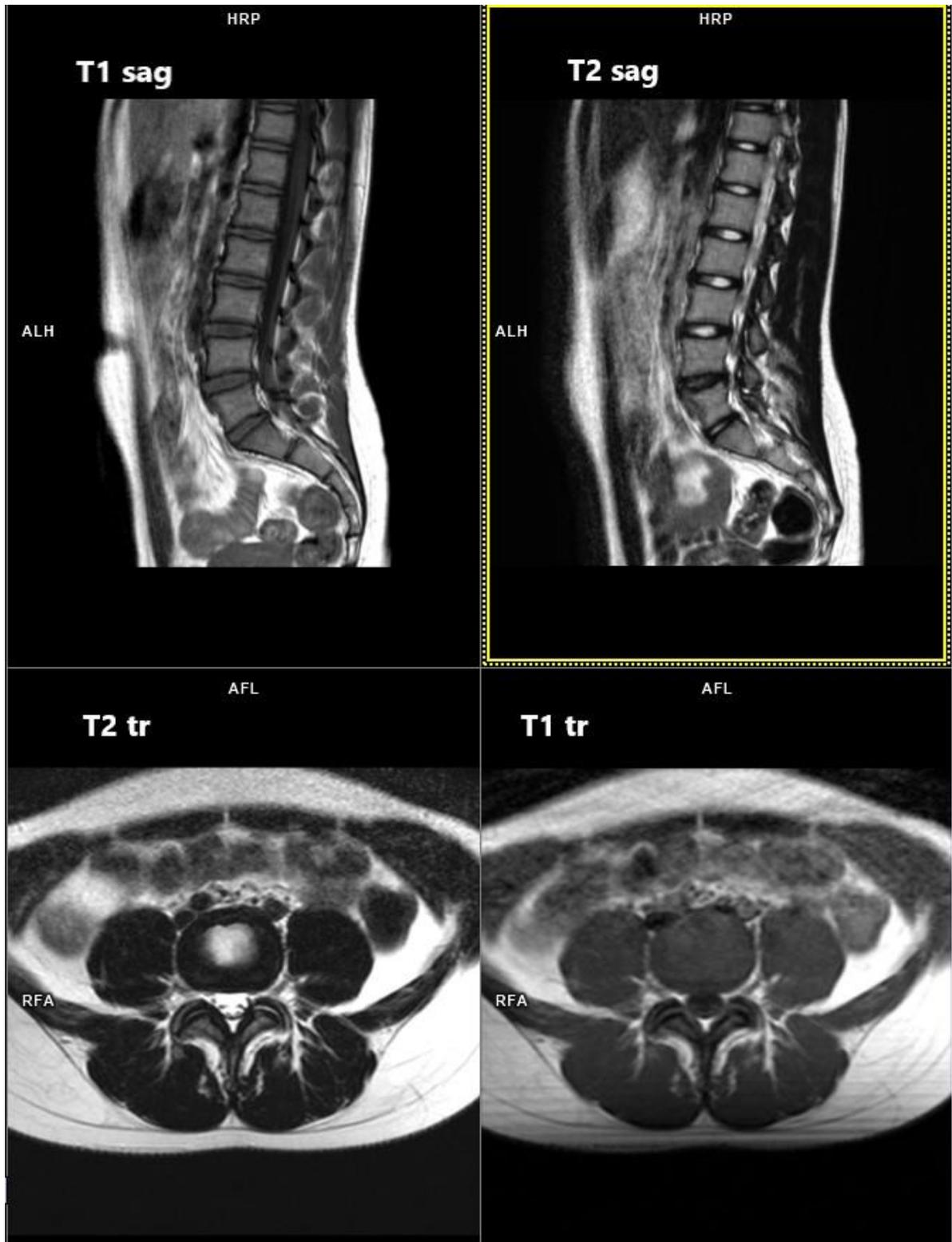


Figure 3. Lumbar spine MRI scan showing disc protrusion on L4-5 segment and disc bulging sign on L3-4 and L5-S1 segments.

(17). Dynamic neuromuscular stabilization program is characterized by the methods and principals of science in the field of developmental kinesiology. Core stability program, regulated by the central nervous system, is achieved through accurate coordination of abdominal muscles, spinal extensor muscles, gluteus muscles and intra-abdominal pressure (18). A multi-faced controlled exercise program has a role to protect the spine from numerous types of injuries and should be considered as part of successful rehabilitation program in youth elite sport. It is beyond dispute that earlier mentioned changes in maximal oxygen distribution in skeletal muscles, decrease in muscle capillarization, decrease in hemoglobin content and changes in muscle fibers gathered with training misconception can be an open door to injury occurrence in elite athletes if the methodical choice of training techniques is absent.

CONCLUSION

Sudden cessations of training due to lockdown in COVID-19 pandemic followed by an immediate return to sport pose a high risk of injury occurrence. This case report is an example that cumulated multiple injuries can occur as a consequence of unsupervised training and detraining due to COVID-19 pandemic lockdown and the impact it has on the elite athlete's life. According to new arose situation, we suggest that sporting federations in collaboration with medical advisers, coaches and judges work close together in developing and implementing sport-specific guidelines to prevent a rapid increase of injuries in different sport disciplines. It is after all, uncertain how long will these specific situations last and we have to be ready to protect athletes' health during and after the year in which the most unique Olympic Games of the modern era were held.

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NOTES

Conflict of interest:

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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