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Design and Manufacture the Safety Conveyor Device in Treadmill Maximal Tests

Bagher Shoja Anzabi[1], Raziyeh Ramazanzadeh [2], Aidin Valizadeh Oranj[3], Marefat Siahkouhian [4*]

1. Department of Sport Physiology, Faculty of Educational Sciences and Psychology, University of Mohaghegh Ardabili, Ardabil, Iran. Email: bshoja48@gmail.com, *Orcid: 0000-0002-1852-0448*
2. Department of Sport Physiology, Faculty of Educational Sciences and Psychology, University of Mohaghegh Ardabili, Ardabil, Iran. Email: ramazanzadeh1223@gmail.com, Orcid: 0009-0008-6512-0763
3. Department of Sport Physiology, Faculty of Educational Sciences and Psychology, University of Mohaghegh Ardabili, Ardabil, Iran. Email: valizadeh@uma.ac.ir, Orcid: 0000-0002-5890-4972
4. Department of Sport Physiology, Faculty of Educational Sciences and Psychology, University of Mohaghegh Ardabili, Ardabil, Iran. Email: m_siahkohian@uma.ac.ir, Orcid: 0000-00002-2166-897X

ABSTRACT

The purpose of this study was to design and manufacture the safety conveyor device in treadmill maximal tests. This device was designed and manufactured considering the subject not falling off the treadmill, and not getting injured during a maximal test. First, the safety conveyor device, was made in small sizes of 30 cm as a prototype before, so that the size of the device can be examined and evaluated realistically. Then a sample was made with iron alloy. The results indicate that the safety conveyor device in the prototype did not have the ability to withstand overload, however after strengthening the conveyor device protector, it acquired the ability to maintain the overload. The safety conveyor device, which has the ability to open and close, prevents the subject from falling and getting injured during extreme tests.

Keyword: Manufacturing, safety conveyor device, treadmill maximal tests.

Corresponding Author: Marefat Siahkouhian, Professor of Sport Physiology, Department of Sport Physiology, Faculty of Educational Science and Psychology, University of Mohaghegh Ardabili, Ardabil, Iran. E-mail: M_Siahkohian@uma.ac.ir. Tel: 09144511435

INTRODUCTION

Treadmills are often used in research, clinical training and education. For example, a 2017 U.S. National Runners Survey found that 14% of runners prefer to run on a treadmill. This exercise is also often used as a form of complementary training among elite athletes [1].

Treadmills are one of the most effective types of exercise equipment. Exercise is essential for overall health, but many older men or women have difficulty doing the recommended 150 minutes of moderate-intensity exercise per week. Some people may have limitations that prevent them from doing traditional exercises such as walking and running. Several studies in biomechanics have reported differences between running on a treadmill and running on the ground [2].

A treadmill also has a special place among these recreational and sports activities. This device can be used as a mean for aerobic activities in inclement weather conditions, such as walking and running, at home or in gyms, helping the elderly and the sick. Be used. On both longitudinal sides of some treadmills, there are two bars approximately one meter higher so that the runner can hold with her hands while running. These bars also give beginners more confidence when running and protect them from potential injuries. But these rods don't just prevent people from falling off the treadmill, and it must be noted that holding the rods affects the energy consumption. The movable turntable is able to create different controllable slopes from zero to 24%. If the slopes are high, the activity on the movable plate becomes more difficult and this can increase the intensity of walking or running [3].

There are two ways to control the intensity of an exercise on the treadmill:

Speed and Slope.

Speed and incline are both automatic in advanced devices. They also show the heart rate, energy consumed in calories, distance, and time of activity, slope and speed. At the end of the activity, the device stops with the push of a button. In some devices, whenever the runner slows down due to fatigue or any other reason, an electric eye at the end of the device automatically shuts off the device so that there is no harm to the runner. In some advanced devices this is done with a magnetic key. In this way, the magnetic key is connected to a magnetic property in a special place and is installed to the runner's clothes by a thread and a clamp, so if the magnetic key is detached from its place, the device is turned off [3].

Body Support Systems

In the past 3 decades, neurological injuries have been the leading cause of morbidity and second leading cause of death worldwide [4]. About 60% of patients show gait disturbance, which greatly contributes to the burden of the disease. The goal of the motor rehabilitation programs is to rehabilitate patients' walking capacity and reduce the number of patients who are prone to gait disorders and are unable to support their full body weight without much help. Body weight support (BWS) is a promising way to re-train physiological walking and prevent compensatory patterns and compensatory strategies. Evidence of this is the numerous devices on the market that are currently under development and have an increasing uptrend in the rehabilitation classification. [5]. The BWS makes mobility possible and easy and is usually provided with braces that apply vertical forces to the pelvis or torso to achieve a relative reduction in gravity, along with fall prevention mechanisms, which provide a safe and authorized environment for early motor training as well as training of many skills. BWS systems provide special benefits for motor training:

1) BWS maximizes the controlled weight tolerance on legs, which increases lower limb electromyographic activity and limb coordination through appropriate sensory input and walking.

2) BWS lets patients to rotate their arms naturally, thus preventing forward movement and balance, the ability to control the dynamics of the body position to prevent falls.

3) The natural oscillation of the arm activates the rhythmic flexors and stretches of the shoulder, which enhances the pattern output of the spinal motor networks, thereby supports positive neuroplasticity.

4) BWS avoids compensatory balance strategies that use the arms and therefore it leads to maximal motor learning [6].

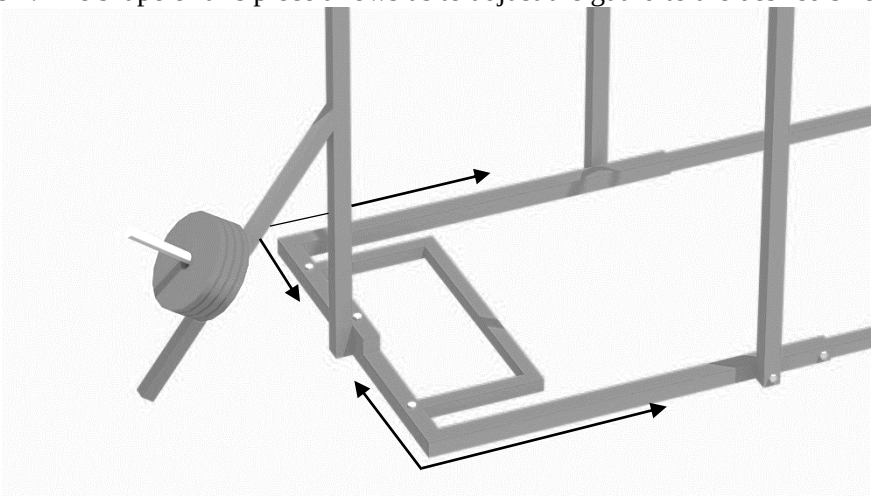
Over the years, BWS systems have been developed in more detail, using fixed treadmill systems and connecting to highly supportive systems that allow walking on the treadmill and on the ground. This is especially important in evoking physiological gait patterns that can change into a completely unsupported environment.

The second group of devices are roof-mounted systems that are based on the installation of a rail. In the latest BWS systems, the possibility of physiological training of various activities with only a slight deviation is provided and is an effective way to train balance control [7].
BWS single-rail systems inherently generate pendulum forces. When patients deviate too far from the midline, these bodybuilding forces move the BWS straight to the rail.
Banwart et al. (2020)[1] investigated that body weight support can affect patients' with neurological disease ability to walk. The results of this study showed that in addition to spatio-temporal parameters, dynamic stability is also clearly affected by the BWS [8].

Dynamic Modeling and Simulation of Body Weight Support System (Stroke Patients**)**
Body weight support treadmill (BWSTT) exercises are commonly used in post-stroke gait rehabilitation. Restraint support reduces the load on the lower extremities when walking and significantly reduces the spastic response of the lower extremities while walking. Further restraint minimizes the risk of falls and allows walking trainings in the early stages of stroke recovery. The brain starts, so it provides more opportunity to learn to walk than to walk on the ground. However, BWSTT was effective for those who were able to walk independently on a plain playing field. Likewise, it can be assumed that the effectiveness of BWSTT is affected by the ability of the foot to walk. studies of Murray et al. (2020)[2] on BWSTT in 17 stroke patients showed that bilateral symmetry while walking on the ground before training was associated with the measured effectiveness of BWSTT [9].

MATERIALS AND METHODS
Components
1- Conveyor mounting bases:
2- Connection profiles of support bases and main column
3- Main columns
4- Profile of can weight holder above the subject's head
5- Protective belt

1- Round Connection Bases:
Profiles in the dimensions of one meter 4 × 4 cm with a thickness of 2 mm with the length of one meter are installed on the strip bases on both sides, which maintain the protective balance of the strip inside these bases by sliding the iron can profile 3 × 3 cm with a thickness of 2 mm in the size of 1.20 cm in length. To adjust the size and keep the profile of the 3 × 3 cans fixed, bolts and nuts have been used. At the beginning of this piece of tape guard, in each of the bases, there is a 4 × 4 cm profile with a length of 40 cm. The shape of this piece allows us to adjust the guard to the desired size of the treadmill.



١. Bannwart et al.

٢. Mori et al.

Figure 1. Bases attached to a treadmill

2- Bonding Profile of the Retaining legs and the main Column

The profile of the iron can is 5.5 cm long by 80 cm. piece L is inside this support base of the main column. Two cans of 20 cm are connected to this piece from the front and a profile of 7 cm in size is also attached to these two cans of 20 cm. The combination of these pieces creates a rectangle on both sides of this rectangular piece. There are angles that are placed on the support bases to reduce the force on the main pillar and prevent the balance of the main pillar from being disturbed.

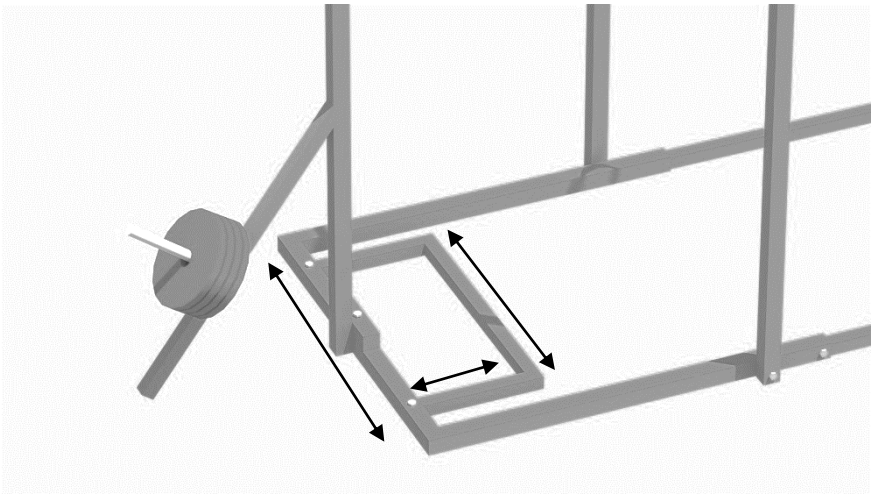


Figure 2. Main pillar support base

3- Main Columns

This column consists of six parts. The first part, which is connected to the connecting profile of the strip protection bases, is 5×5 cm with a thickness of 2 mm and a length of 1.5 cm. At the end of this piece, there is a place for placing weights so that it can maintain the protective balance when the subject's weight is placed on it. The second part of the profile is 4×4 cm with a thickness of 2 mm and a length of 1.5, which is sliding inside the profile of the first part and is responsible for adjusting the height of the revolving guard on the 4×4 profile. There is a connection of parts to each other and height adjustment, which are connected in the form of bolts and nuts. The third piece is placed on top of the test piece inside the main column and is fixed with bolts (Figure 3).

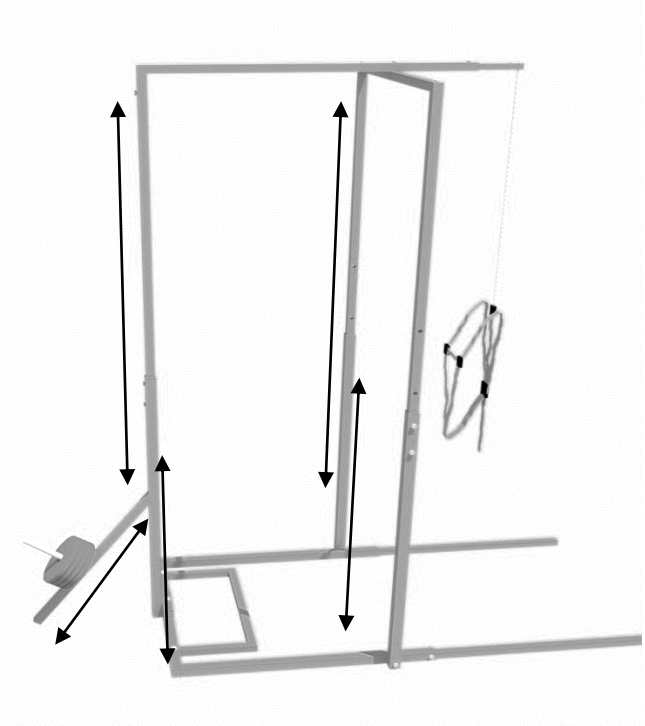


Figure 3. Placing the columns sliding inside each other and fixing them with bolts and nuts

4- Profile of the can weight holder above the Subject's head

This weight holder consists of two pieces, the first piece in the dimensions of 4×4 cm and a length of 1.5 meters and the second piece in the dimensions of 3×3 cm and a length of 1.75 cm. At the end of the first piece, to for adjusting and holding the second piece, which moves slidingly, there is a hole that adjusts the length of the holding box profile above the subject's head and is fixed with bolts. At the end of the second part, there is a hole for installing the protective belt, which makes it easy to connect the ring and the belt.

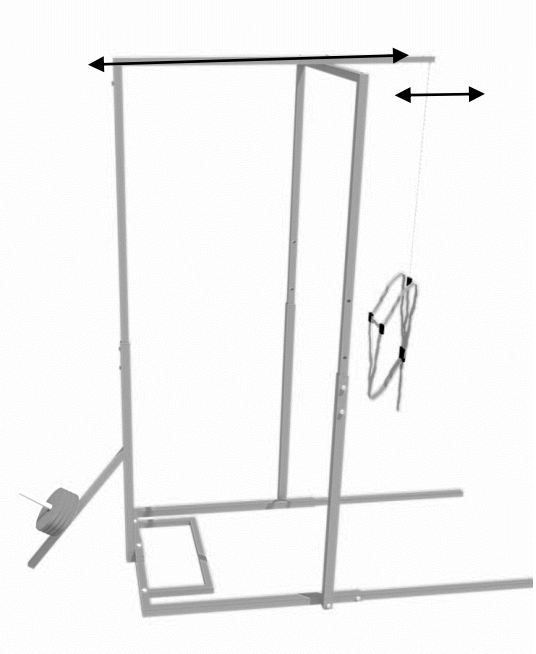


Figure 4. Body weight support column above the subject's head

5- Protective
The protective belt attached to the highest point of protection of the turntable, is in the end of the weight support profile above the subject's head and closes without any disturbance for the subject's waist.

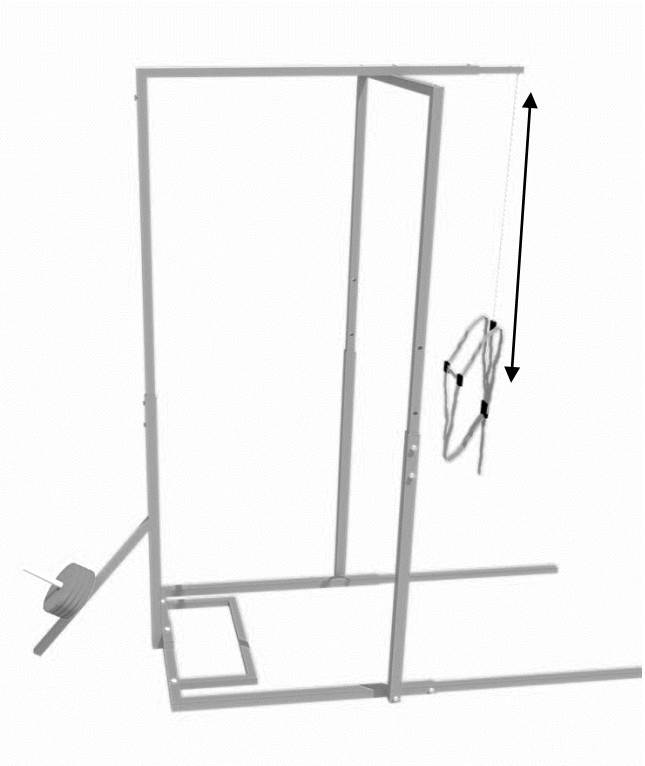


Figure 5. Weight bearing belt

Cheapness
1- Being cheap
2- Easy installation
3- Prevention of athletes' injuries

Installation steps of the device
1- First, the support bases that are placed on the ground next to the treadmill are adjusted to the size of the treadmill and we slide it inside, then we fix the support bases with screws and seals.
2- The main columns, each of which is composed of two separate pieces, are first connected to the pieces connected to the base by bolts and then to the second pieces of each of the columns, which are sliding inside each other with bolts and nuts.
3- In the next step, the bar above the subject, which is responsible for holding the person, is placed on top of the device and on the base column. This rod is connected to the device's bases with bolts and nuts, and it is fixed in place with bolts and nuts.
4- The seat belt is embedded to the hole that is in the column above the subject's head.

RESULTS & DISCUSSION

The goal of the present study was to design and manufacture a swivel guard in the maximum tests to prevent the subjects from falling off the swivel. Professional athletes and patients with limited mobility start the test after standing on a treadmill and wearing a belt. The console guard prevents the subject from falling and damaging by a belt attached to the subject.When the subject is in danger or falls off the treadmill.
Since the treadmill is a universal tool for exercise and is used by many people, both athletes and patients, the treadmill protector can play an important role in maintaining the health of patients and athletes by installing a treadmill protector in clubs. Both in sports testing centers and medical offices, a safe environment for testing can be created.

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طراحی و ساخت دستگاه محافظ نوار گردان در آزمون‌های بیشینه

باقر شجاع انزابی[۱]، راضیه رمضان‌زاده[۲]، آیدین ولی‌زاده اورنج[۳]، معرفت سیاه‌کوهیان[۴*]

۱- گروه فیزیولوژی .رزشی، دانشکده علوم تربیتی و روانشناسی، دانشگاه محقق اردبیلی، اردبیل، ایران.
۲- گروه فیزیولوژی .رزشی، دانشکده علوم تربیتی و روانشناسی، دانشگاه محقق اردبیلی، اردبیل، ایران.
۳- گروه فیزیولوژی .رزشی، دانشکده علوم تربیتی و روانشناسی، دانشگاه محقق اردبیلی، اردبیل، ایران.
۴- گروه فیزیولوژی .رزشی، دانشکده علوم تربیتی و روانشناسی، دانشگاه محقق اردبیلی، اردبیل، ایران .

چکیده:

هدف از تحقیق حاضر طراحی و ساخت دستگاه محافظ نوارگردان در آزمون‌های بیشینه می‌باشد. محافظ نوارگردان (تردمیل) برای جلوگیری از آسیب دیدن آزمودنی‌هایی که بر روی تردمیل در حال دویدن برای آزمون می‌باشند. طراحی و ساخته شده است. در قسمت طراحی محافظ نوارگردان ابتدا برای به دست آوردن اندازه‌های دقیق، نوارگردان را اندازه‌گیری، سپس برای نمونه اولیه قبل از شروع کار، ماکت چوبی محافظ نوارگردان در ابعاد کوچک در اندازه ۳۰ سانتی متر طراحی و ساخته شد. برای ساخت نمونه اصلی بعد از تحقیق و بررسی روی انواع پروفیل‌ها تصمیم بر این شد، از پروفیل قوطی آهنی برای ساخت محافظ نوارگردان که از مقاومت بالا و همچین وزن کمی که نسبت به پروفیل‌های دیگر داشت استفاده شد.

واژه‌های کلیدی: طراحی و ساخت، محافظ نوارگردان، آزمون‌های بیشینه