International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 7, 2020
ISSN: 1475-7192

The effect of visual feedback and shouting on the maximum muscle strength of the grip, quadriceps femoris and hamstring

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Abstract

Background/Objectives: The purpose of this study was to ensure that applying visual feedback and shouting at the same time during exercise is effective in improving the maximal strength.

Methods/Statistical analysis: The visual feedback and shouting were applied randomly simultaneously to the basic movement of 30 healthy adults, and the grip strength was compared through repeated measurements, the knee muscles involved to the quadriceps femoris, and the femoral muscles applied to the hamstring.

Findings: The grip strength was a slight muscle improvement in the group applying visual feedback over the experimental group and in the group applying shouting over the experimental group, the right knee extension quadriceps femoris was a significant improvement in the group applying visual feedback ($p<.01$) and the left knee extension quadriceps femoris was enhancement in the group involving visual feedback over the experimental group ($p<.01$). The right knee flexion of hamstring was a significant improvement in the group comprising visual feedback ($p<.01$), and the left knee flexion of hamstring was an enhancement in the group applying visual feedback over the experimental group ($p<.01$).

Improvements/Applications: The results of the study showed that the group improved the maximum muscle strength of the quadriceps femoris and hamstring muscles in the lower extremities with visual feedback and shouting. Furthermore, comparing maximum muscle strength with visual feedback and shouting has shown that shouting is more significant.

***Keywords*:** Visual feedback, Shouting, Maximal strength, Grip strength, Quadriceps femoris, Hamstring

1. Introduction

Modern people create many real problems because of their sedentary lives at work and school. First, the sedentary lifestyle, the less physical activity, which leads to a decrease in strength. Secondly, prolonged sedentary life leads to impaired blood circulation, chronic diseases, and edema. One way to solve this problem is to maintain an appropriate level of strength for all individuals. The general population promotes the performance of daily living activities and affects the mortality rate of the elderly [1]. This is especially important for athletes because they need the ability to generate maximum force for competition in sports competitions [2]. Stastny et al. (2018) published a study using monitor visual feedback during exercise that muscle feedback was higher when muscle feedback was higher than when visual feedback was given to the same subject [3]. Visual feedback is also associated with influencing the amplitude of force fluctuations [4]. Tennis players and other athletes screamed to improve strength generation and showed improved performance [5]. This is called psyching-up. This means that during an activity that requires more strength, the muscles scream consciously or unconsciously. Sound improves strength by increasing awareness and confidence in psychological sensations. This increase is manifested regardless of the cry experience, the benefits of the cry, and gender [6]. Thus, among many methods for muscle training, research has been conducted on muscle training methods using sensory feedback such as vision and hearing [7]. Grip strength, which can represent an individual's muscle strength, is considered clinically significant [8]. Static grip strength was measured much higher using all linguistic encouragement and visual feedback [9]. Also, prior studies have shown that the strength of the grip and femoral muscles is related to health outcomes, including quality of life, daily life disorders, hospital visit times, hospitalization and walking speed [10]. Previous studies also reported that grip strength and Quadriceps femoris muscle strength are related to health outcomes, including quality of life, daily life disorders, hospital visit times, hospitalization, and walking speed. If grip strength and Quadriceps femoris' muscular strength are reduced, they can be distinguished from those whose health has

deteriorated. Quadriceps femoris clinically strives to maintain proper muscle strength because it affects the safety of knee joints and the prevention of injury. Quadriceps femoris is an agonist of standing posture and walking stability, especially knee arthrodesis, with the essential muscle around the knee joint [11]. He also said that if the ratio of Quadriceps femoris to Hamstring muscle strength drops, the risk of Hamstring injury increases. According to Lee and others (2018), the percentage of muscle strength between Quadriceps femoris and Hamstring was reported to be related to injury [12]. Hamstring's injury has a wide variety of factors, including muscle weakness among them. [13-16] In other words, you can see that Hamstring plays an essential role in physical functions as well as in the importance of Quadriceps memory.

Commonly used forms of exercise enhancements include Isometric exercise, Isotonic exercise, and Isokinetic exercise. To provide a method for measuring an Isokinetic exercise, which can be evaluated objectively and accurately. The isokinetic excursion is an exercise method performed by optionally fixing an exercise speed, imparting an external resistance to muscle force, and maintaining an absolute angular velocity. Such an isokinetic accident can be utilized for various exercise purposes in that it can be used to train muscle contractions at speeds that are not caused by Isometric, Isotonic muscle contractions [17]. Maximum Voluntarily Isokinetic Contract, MVIC, is used to measure and assess muscle strength in a very important way with high reliability [18]. Although many studies have been reported on how to provide feedback on one method and guide maximum muscle strength, there is not enough research on how to compare visual feedback with shipping and how it affects muscle strength. Therefore, the study looked at the impact of visual feedback and shouting on the grip, Quadriceps femoris, and Hamstring during Isotonic exercise.

2. Materials and Methods

2.1. *Subject*

In this study, a total of 30 healthy adults and 15 males and females participated in the study, randomized, and single-blind study at S University, A. The subjects who participated in this study met the following selection criteria, and the subjects who voluntarily completed the agreement in writing after receiving the full explanation of the purpose and method of the study themselves are shown in [Table 1]. The selection criteria of the study subjects were 1) those who had no knee and musculoskeletal disorders within 6 months 2) those who had no history of surgery related to lower extremities 3) who were not admitted to the hospital due to pain in the knee or who did not receive medical treatment 4) knee nerves Those who were not accompanied by chemical injury were selected. The Institutional Review Board approved this study (IRB), (SM-201904-020-1).

Table 1. Physical characteristics of subjects N=30

	Subject
Age (years)	20.60±1.61
Hight (cm)	167.57±8.35
Weight (kg)	62.10±13.3
Male/Female	15/15

*Values are Mean±SD

2.2. *Measuring equipment*

In this study, decibel measuring equipment was used for uniformity of the size of shouting sound[Figure 1], and it was measured using isokinetic measuring equipment[Figure 2] and grip strength measuring equipment[Figure 3].

Figure 1. Sound level measuring equipment

Figure 2. Isokinetic strength measuring equipment

Figure 3. Grip strength measuring equipment

2.3. *Measurement method*

To see how visual feedback and shouting affect maximum muscle strength during isokinetic exercise and grip strength measurement, the grip strength measurement equipment was used. The experiment was conducted twice, and the overall research process is shown in [Figure 4].

To determine the maximum strength, the peak torque of the basic exercise only when visual feedback was given when the muscle strength of the quadriceps and hamstring muscles was shouted at a speed of 60 ° / sec using the isokinetic exercise measuring equipment. The values will be compared and measured. At this time, the knee bone was aligned with the axis of rotation by dynamometer, and the upper body was fixed by Stabilization belt to prevent the external force from acting during flexion/extension of the knee joint. The elbow joint was measured in a flat state without being attached to the trunk.

Shouting set the average decibel value at an average of 75-90 dB and measured it at a distance of 75 cm from the subject to maintain a constant average decibel value. When the strength graph comes out, we will point out more points to give them visual feedback so that we can reach further points. The height of the monitor was fixed according to the eye level of the experimenter.

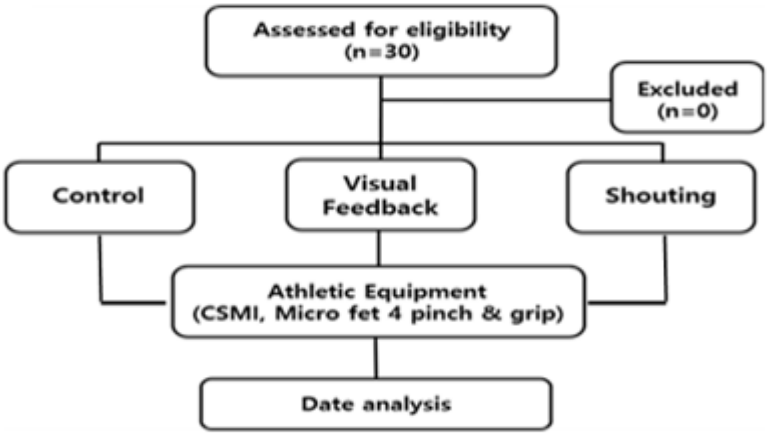

Figure 4. Experiment protocol flow chart

2.4. *Statistical analysis*

SPSS statistics22 for Windows was used to obtain the statistics of this study. Parametric tests were used in the normality test, where means and standard deviations represent the measurements, and the samples are normally distributed. Repeated-measure ANOVA was used to compare men and women in one group, divided into primary exercise groups, visual feedback group, and shouting groups through the grip, quadriceps, and knee muscles. The assay used the Bonferroni correction test.

The significance level α for the statistical significance test was set to .05.

3. Results and Discussion

[Table 2], [Table 3], and the Quadriceps femoris and Hamstring representing these grips are the standard state and sound. The average of the average peak torque values was increased by 21.43%, 29.16% on the right side, and 27.3% on the right side of the hamstring, and 23.2% on the left side. Shouting quadriceps, compared to visual feedback, increased by 0.17% on the left, and neutralization increased by 4.17% on the left, 2.77% on the right, 12.87% on the right thigh.

Also, the visual feedback group and the outside group were statistically significant in all groups except grip, compared to the primary exercise group [Table 3]. Also, in the flexion and shock movements that appeared significantly, the maximum muscle strength was more improved in the group to which the visual feedback group was applied.

The purpose of this study was to investigate the effects of visual feedback and shouting on gripping force, quadriceps,

and knee muscle during isokinetic exercise by comparing visual feedback and shouting. As a result of this study, the maximum muscle strength of quadriceps femoris and Hamstring, which is the lower extremity muscle strength, was significant, but there was no significant effect on the grip strength.

Performing with visual feedback has been reported to increase explosive muscle contraction [19–21]. In particular, the maximum strength of Quadriceps femoris and Hamstring reported a greater increase [22]. However, other athletes have shown improved performance by shouting to improve muscle strength production [5]. Shouting is the act of making a sound in order to make a strong moment in your daily life or sports scene. Shouting, unlike the Valsalva maneuver, exhales quickly and exhales, and this behavior increases explosive performance [23]. Therefore, this study was conducted to find out whether the improvement of maximum muscle strength through feedback affects performance or is appropriate to apply as a treatment technique.

To find the maximum muscle contraction, as in the previous study, using CSMI, the maximum muscle strength of Quadriceps femoris and Hamstring at 60 ° / sec as compared to the peak torque through feedback. Also, in order to consistently apply the shouting during the exercise, the decibels representing the relative loudness of the sound were measured and quantified. The study was carried out while maintaining.

In the previous study, visual feedback increased the maximum strength more than the feedback using the constant-velocity measuring equipment monitor, and shouting also increased the maximum strength through the feedback [24]. However, both visual feedback and shouting did not produce significant results when measuring grip strength. Other studies have shown insignificant results when looking at the dial and giving visual feedback, while another study found significant results when providing feedback through the screen by linking the grip strength to the screen. [25]. Thus, the strength of grip through visual feedback of various studies showed different results depending on the environment. Therefore, further explanation of the study is needed.

To get more accurate results, it is necessary to recruit and study subjects of different devices and broader age groups. The study also measured control, visual feedback, and shouting iterations. Measurements were made after sufficient rest between experiments, but the complete recovery from muscle fatigue cannot be accurately stated. It may be necessary to adjust these variables and add them to future studies because they may be affected by fatigue and current condition[26]. In the case of the shouting, the training was carried out in a short period of weeks and a few more years of practice, and the operation was carried out in a short period of time. I think it is necessary.

The limitations of this study are as follows. First, in the previous study, various age groups were collected, but the subjects were composed of 20.67 ± 1.58 year old specimens because the data were collected from S college students in Asan. Thus, age groups may not be generalized. Second, it was conducted in an open space, not in a limited area, and was done in a poor clinical environment due to unfamiliar shouting and awkwardness because of the concentration of subjects, distractions, and untrained members of the general population. Third, when the visual feedback is given, the data that gives visual feedback due to the difference between the two instruments of isokinetic exercise measuring equipment (CSMI) and grip force measuring equipment (MICRO FET4 GRIP) are different from each other. It can be seen that significant differences can be distinct.

Table 2. Comparison of exercise to the base, base with visual feedback, and base with shouting method among three group

Hand Grip (lbs)	Methods of Exercise			F (p-Value)
	BSG	BVG	BG	
Rt.	72.30±4.45	73.13±4.45	71.10±4.45	.053(.849)
Lt.	66.43±4.68	69.27±4.68	65.67±4.68	.164(.949)

Values are expressed as mean ± standard deviation.
BSG, Base exercise with Shouting group; BVG, Base exercise with Visual feedback group;
BG, Base exercise group, Rt. Right; Lt. Left.

Table 3. Comparison of exercise to the base, base with visual feedback, and base with shouting method among three group

Knee (% weight)	Methods of Exercise			F (p-Value)
	BSG	BVG	BG	
Rt. extensor	181.70±6.16	168.83±5.92	147.40±6.16	7.906(.001)
Rt. flexor	132.80±5.60	128.63±5.59	101.33±5.60	9.325(.000)
Lt. extensor	163.80±4.68	163.63±5.92	139.47±5.92	5.590(.005)
Lt. flexor	119.87±5.77	117.10±5.77	93.90±5.77	6.102(.003)

Values are expressed as mean ± standard deviation.
BSG, Base exercise with Shouting group; BVG, Base exercise with Visual feedback group;
BG, Base exercise group, Rt. Right; Lt. Left.

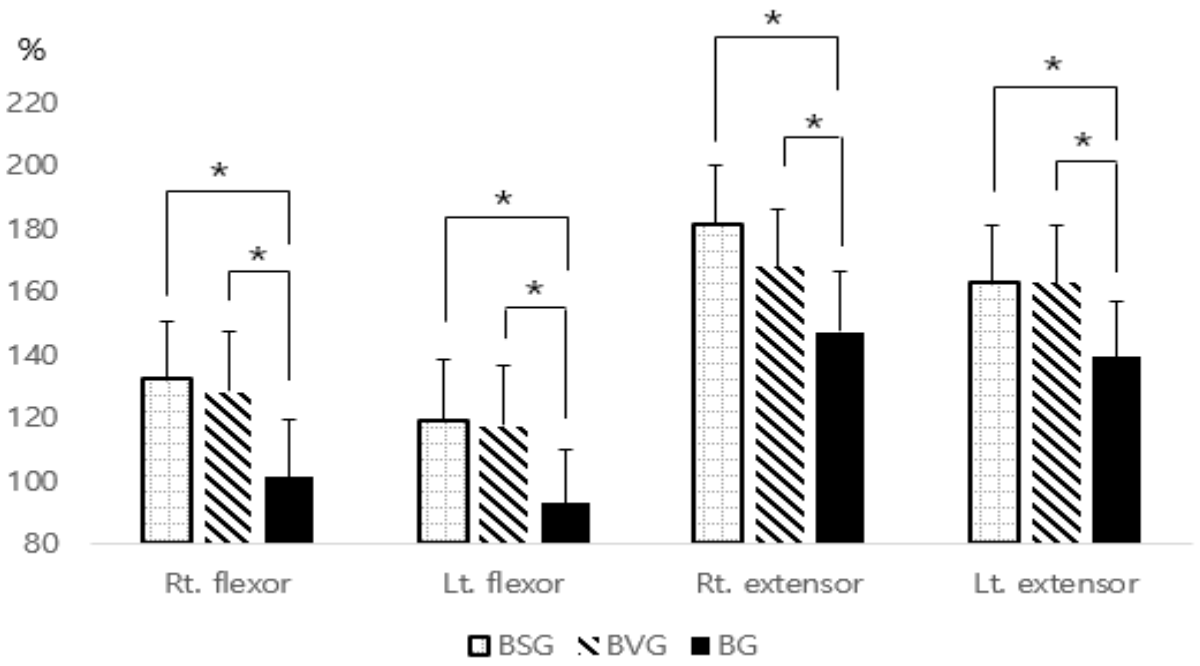

Figure 5. Comparison of the ratio of method at base exercise with Visual feedback to that at Base exercise with Shouting (1, Base exercise in group applying Shouting group; 2, Base ex- ercise in group applying Visual feedback; 3, Base exercise; 4, Rt. Right; 5, Lt. Left.)

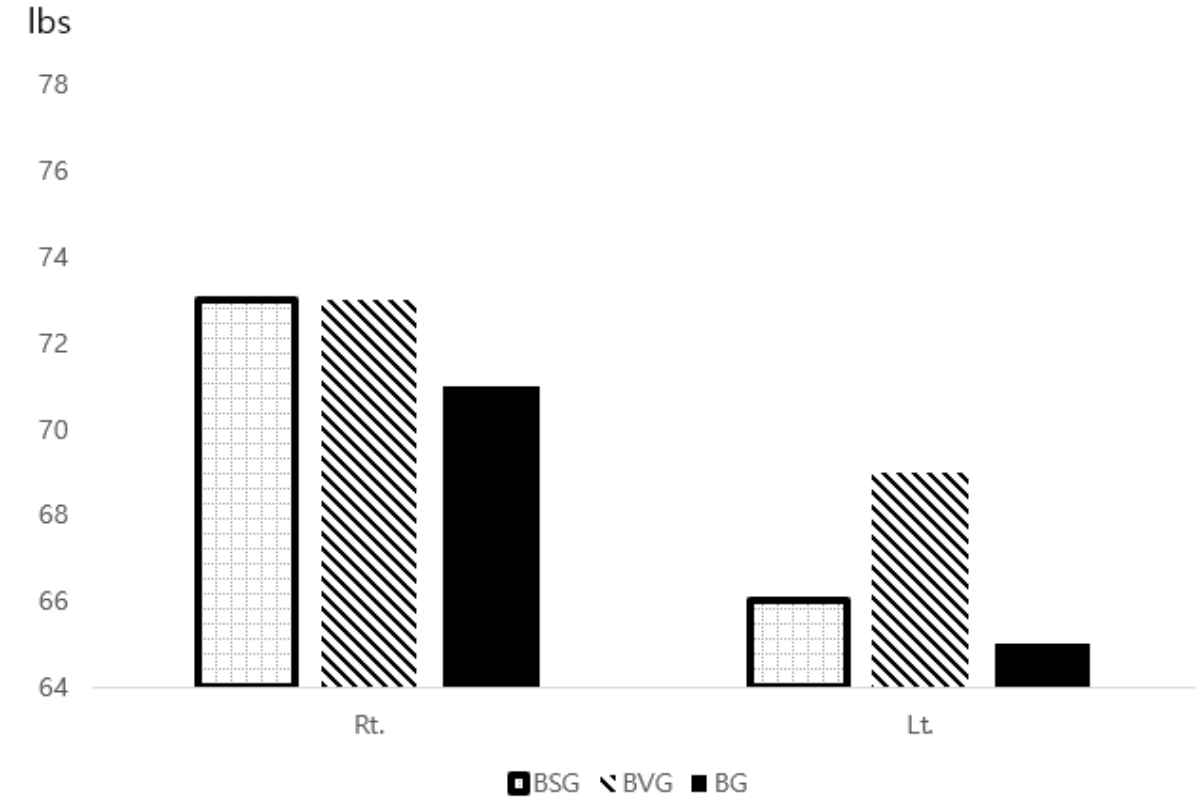

Figure 6. Comparison of the ratio of method at base exercise with Visual feedback to that at Base exercise with Shouting (1, Base exercise in group applying Shouting group; 2, Base exercise in group applying Visual feedback; 3, Base exercise; 4, Rt. Right; 5, Lt. Left.)

4. Conclusion

This study was intended to investigate effective feedback methods for improving muscle strength. The study found that the process of applying visual feedback and shouting increased the maximum muscle strength of the quadriceps femoris and hamstring in the lower extremities more than it did when feedback was not given. And when comparing

visual feedback and shouting, the feedback method using shouting was more effective in boosting muscle strength. However, in the case of grip strength, there has not been much effective in improving muscle strength. Based on these results, we believe that the results can be used as a basis for the application of an exercise program to enhance athletic performance by applying visual feedback and shouting to musculoskeletal and neurological patients or to laypeople and athletes who require increased maximum muscle strength.

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