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Development of High Performance Inner Wear for Karate Players

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Abstract: *Karate is a one of the most participated sport in the world. It has rich history tracing back to china and India. Since starting time of karate, karate players wear "Traditional karate uniform" which is called "karate GI". Today, with the improvement of technology, most of the sports such as cycling, swimming, rugby, athletic etc, are considered in improving the functionalities of relevant sport wear in order to enhance the player's performances. However, according to World karate federation, the outer appearance of karate GI could not be changed. Therefore, the only option in improving player's performance through the uniform is introducing an innerwear which provides good support to the body muscles according to their special movements. Therefore, the objectives of this research were to identifying the requirements of karate players and explore the possibility of introducing an inner garment combined with compression technology and karate safe guards. Through interviews with karate players and instructors, the issues in karate GI was identified and the technological advancement in textile and fashion industry was explored in order to do experiments on developing a inner garment for karate players. This will be a knowledge source for product developers to produce a high performance wear for karate players, which will be a great investment for a great future of karate.*

Key words: *Karate, High Performance wear, Safe Guards*

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I. Introduction

Background of the study

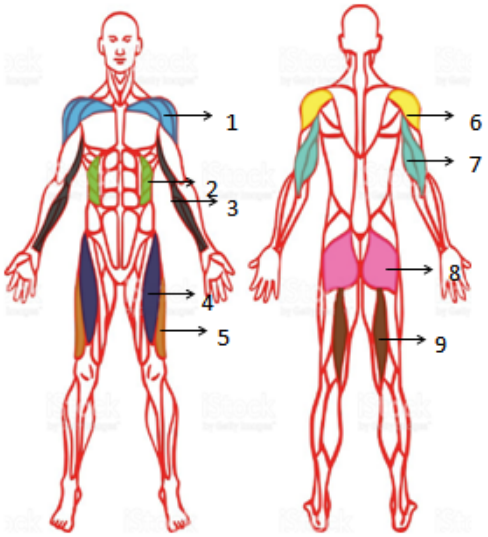
According to the World Karate Federation, Karate is a highly participated sport where there are 100 million practitioners around the world. Karate can be practiced as an art, self defense or as a combat sport. While traditional karate aims at self-development, modern Japanese style training emphasizes the psychological elements such as perseverance, fearlessness, virtue and leadership skills. Sport karate is mainly aimed for exercise and competition and blocking, kicking, punching and take downs are the primary tools that used in karate [1].

Since starting time of karate, karate players wear "Traditional karate uniform" which is called as "karate GI". The upper garment of karate GI has long sleeve up to wrist level and pant length to anklebone level which are not body fitted and also not focusing on providing any muscle support to the player [2]. Today, with the improvement of technology, most of the sports such as cycling, swimming, rugby, athletic etc, are considered in improving the functionalities of relevant sport wear in order to enhance the player's performances. However, according to World karate federation, the outer appearance of karate GI could not be changed. Therefore, the only option in improving player's performance through the uniform is introducing an innerwear which provides good support to the body muscles according to their special movements. Garments for a particular sport are developed considering specialized requirements of the player's working muscle groups related to their movements and the requirements of relevant sport. Karate player's requirements are different from other sports, therefore, a thorough study of karate sport need to be done in order to develop specialized inner garment for karate players.

Further, through the interviews, it was found that the Karate players who need to wear some safe guards additional to the Karate GI, such as Mitts (gloves), Gum shield, Chest guard, Shin pads, Foot protection guard and Groin guard (Fig 1) are not comfortable to the player.

Fig 1. Safe guards used in Karate
(Source: https;//wkf.net/karateprotections)

Main Movements of Karate and Relevant Working Muscles
Fig.2 shows the main body muscle groups that are used in specific movements of karate sport. During the practicing time, those muscles could be damaged or suffered soreness if muscle support would not be persisted [3].



1	Detoild muscle group & pectoralis major
2	External oblique muscle
3	Bicep brachial & forearm flexors
4	Rectus femoris
5	Vastus lateralis
6	Detoild muscle
7	Triceps brachii muscle
8	Gluteal muscle
9	Semitendinosus

Quadriceps femoris

Fig.2. The anatomy of the Karate (Link,2011)

Main Movements of Karate
In karate sport, there are several main movements such as Straight punch, Upper block, Open hand out block, Middle front kick and Turning kick.

Straight punch
With this punch (Fig. 3) the player turn their hand 45 degree to outside which mainly focused back side bicep brachia muscle group (underarm).

Upper block
In upper block (Fig 4), the player's front side bicep brachial muscle group and deltoid muscle group (shoulder area) are mainly focused.

Open hand out block
In this block (Fig 5), the player's body turns 90 degrees to outward focusing external oblique muscle group in both sides.


Fig.3 Straight punch


Fig.4 Upper Block


Fig. 5 Open hand out block

(Source: Basic karate by chantra karate https://www.google.com/search?rlz=1C1CHBD_enLK730LK731&sxsrf)

Middle front kick

In this Middle front kick (Fig 6), the player's external oblique, Quadriceps and hip flexors muscle groups are focused.

Turning kick

In this turning kick(Fig. 7), it mainly focuses on player's oblique, calf muscle, gluteal muscle and Quadriceps muscle.


Fig.6. Middle front kick


Fig. 7. Turning kick

(Source: Basic karate by chantra karate)

Injuries faced by Karate players

It is found through the questionnaire survey and literature review that main injuries faced by karate players during their practice time are damages in Groin area, calf muscles and biceps muscles. Those injuries are common for both male and female players. The injuries sustained in styles that use joint locks and throws may be quite different from those that use kicks, punches, and blocking techniques[4].

Compression wear

Basically, compression wear has been designed to improve player's performance and reduce risk of injuries during their practice time. Compression wear has firstly been used in medical stockings that mainly used to create pressure around muscle, bone and connective tissue[5]. Using this compression wear in sport provide many benefits to player such as keeping the muscle warmth, improving blood flow return and oxygenation to working muscles where it provide speedy recovering to muscle injuries, reducing muscle oscillation (vibration) which involve small tear in the muscle tissue along with a buildup of lactic acid and providing support to player's muscles [6,7,8].

Different methods are available in providing compression such as, zonal compression, gradual compression and regular compression. Zonal compression is a method of giving compression to specified muscle group which is called as "muscle forced compression". In gradual compression, compression gradually decreasing ups the garment and in regular compression it provides compression around the body equally. Out of above three methods, gradual compression method support smooth flow of blood towards the heart[9].

Normally, for compression clothing, a fabric which is a combination of spandex and nylon has been used due to its stretchable and recovery properties. However, with the advanced technology, high modules fabric has been developed which has the property of fast recovery and ability to apply moisture management property which is a prime requirement for sports inner wear.

When applying the gradual compression method to the garment, flock prints and silicon prints which bear the property of blocking the stretchability of the printed area can be used. Therefore, the fabrics with these prints hold the particular muscle very well and reduce unnecessary muscles movements. Hence, it provides a good support to player's muscle reducing muscle soreness and muscle damages.

Problem Identification

According to the questionnaire survey done by the researcher in order to get karate players' views on their karate GI and injuries they faced during practicing, it was found that majority of players have complained that they are not comfortable with karate GI, mainly because of the safe guards which need to wear separately.

Further, it revealed that 60% of participants have faced injuries in their muscles, especially in biceps and thigh area. Therefore, the main aim of this study is to develop an inner wear for karate players where safe guards can be incorporated to the garment while adding compression feature to particular places of the garment in order to improve the performance of the player.

II. Methodology

In order to achieve the above aims, experiments were done by developing several samples incorporating safe guard insertion methods. Further, nylon spandex mix fabric samples were printed with gradient print (Fig.8) which provides gradual compression using flock printing method.

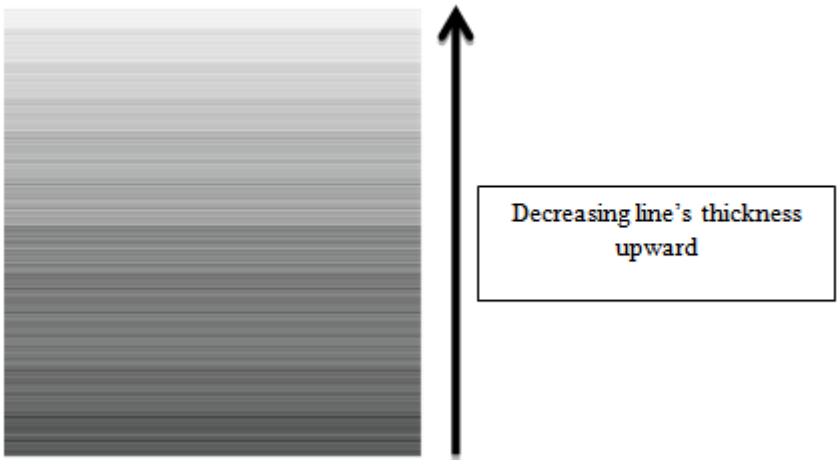


Fig. 8 Art work of gradient print

The illustration of the proposed inner garment for karate GI is shown in Fig.9. In order to insert the safe guards, sleeve and pant patterns were modified by adding panels and layers to the particular places of the garment. The fabric with gradient print was suggested for bicep area of the sleeve, sides of the upper body, thigh area and calf area by studying the player's muscle movements.

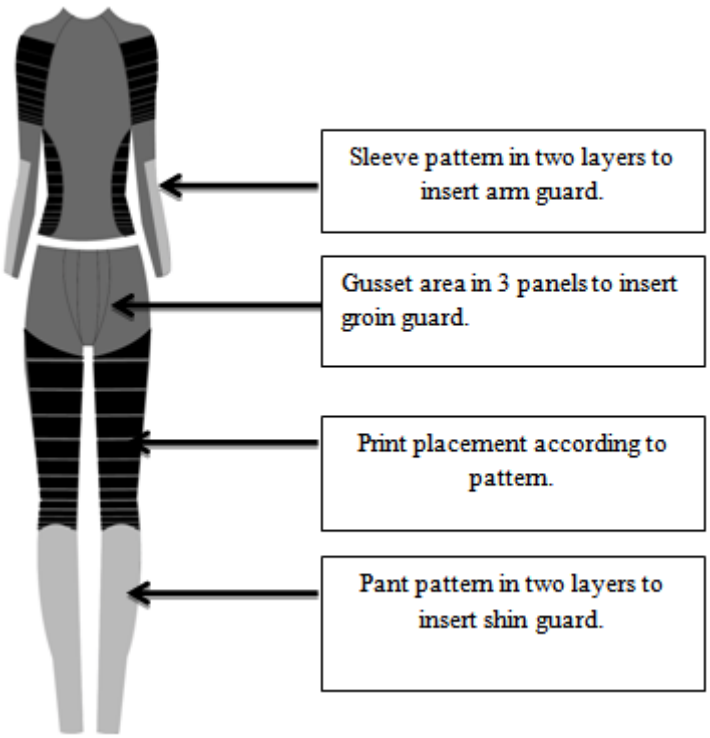


Fig 1. Illustration of Suggested Inner garment

III. Results and Discussions

As explained in section II, several experimental samples were done to explore the feasibility of suggested improvements in the inner garment. Accordingly, front side of the pant leg and sleeve pattern was developed in order to insert safe guards by adding two fabric layers and add key open to easily insert safe guard to it. Further, safe guards were developed by using quilting panels because existing safe guards which are much rigid, difficult to insert through a narrow key open.

Method for inserting shin guard and arm guard

Fig 10. Improved Pant leg with key open

Fig 11. Flat seam of the sample

Fig.10 shows the developed sample of a pant leg in order to insert a safe guard. The pattern was split into panels and added two layers where safe guard needs to be inserted. Key openings were planned to insert safe guards which are flexible quilted ones. Flat seams were used in order to reduce the bulkiness and maintain the stretchability (Fig.11).

Fig.12. shows the developed sample of the pant with a shin guard. According to the wearer's feedback, the experimented pant sample was very comfortable with shin guard because it is inserted to the pant itself. The safe guard is light weight and flexible which makes the wearer comfortable for his/her movements during karate game.

Fig 12 Pant leg sample with a safe guard inserted

Method for inserting Groin guard

In order to insert groin guard, pant front side is planned with four panels which facilitate more space for groin area. By adding a second layer with a key open at waist level, quilted guard could be inserted (Fig.13).

Fig. 2 A. Groin guard insertion method

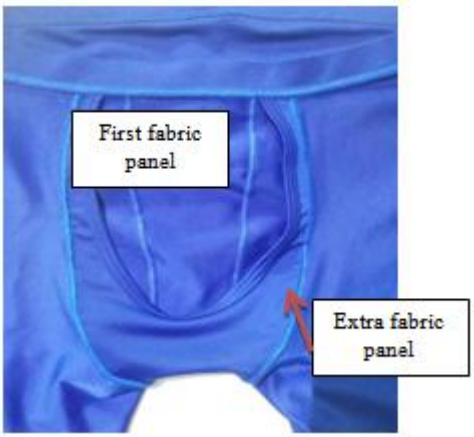


Fig. 3 B. Groin guard insertion method(inner side)

Gradient printed fabric

As explained in section II, the inner garment was suggested to use fabric panels with gradient print in order to give gradual compression to specific muscles of the player. The fabric sample was printed with flock printing method (Fig.14) and the printed sample showed a good control on its stretchability which get reduced towards the top. Therefore, by adding this printed fabric to the inner garment, a varying compression to the required muscles of the player could be achieved. This will support the player in improving performance while refrain from muscle injuries.

Fig. 4 Gradient printed fabric sample

Validation of the result

The developed experimented samples were validated by getting feedback from relevant parties such as karate players, karate instructors, a medical doctor, and technical personnel from apparel industry. Regarding the shin guard inserted pant, the fitted- on karate player mentioned that she had realized her muscles were well fitted and comfortable with the inserted safe guard. Further, she requested to widen the key open for easy insertion of shin guard. The karate instructor informed that the idea was very novel and practical and the players would definitely motivate in wearing this kind of inner garment. According to the medical doctor, gradient compression is good for specific muscles of the players while they do practicing and also their muscles get recover fast reducing their muscle soreness and muscle damages.

According to technical personnel from apparel industry, flock prints limit the stretchiness of spandex mix material. When gradient lines are added as print artwork, the amount of stretchiness of fabric will differ causing gradual compression to muscles. Further, the selected flat seams reduce the thickness of the seam providing more comfortability to the wearer.

IV. Conclusion and Recommendations

It's proven by this research that there are some issues with the Karate GI which need improvements incorporating current technology. Scientists are experimenting to develop player's performance where compression garment is one of the valuable concepts. However, karate players don't have any high performance wear mainly because of the restrictions in karate GI. Therefore, in this research, it is explored an inner wear which comprised of safeguards and gradient print panels which provide gradual compression for specific body parts of the karate player. Experimental samples were done and feedback was received from relevant personnel. According to them, the proposed inner garment could be highly recommended as very effective one for karate players.

In sport wear, groin area could be molded to achieve smooth three dimensional shapes. Further, instead of spandex mix fabric, high modules fabric which has more compression and recovery properties could be used with moisture management finishes applied.

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