Textile Product Design and Development
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Lecture - 15
Ergonomics (contd.)

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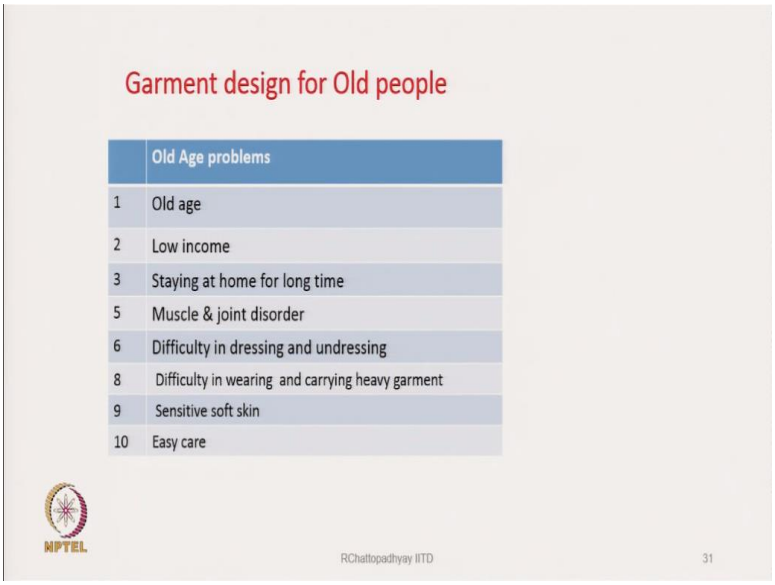

The example stated is designing a garment for older adults. This slide outlines ten age-related challenges. One significant issue is the effects of ageing itself. Additionally, many older individuals experience reduced income due to retirement, often resulting in financial constraints. Furthermore, they generally tend to spend extended periods at home, leading to a preference for comfort and practicality in their clothing.

They often face muscle and joint disorders, which are common age-related issues. As a result, they may experience difficulty dressing and undressing and challenges with heavy garments. Many people prefer lightweight clothing, as heavy fabrics can be uncomfortable and are often rejected. Additionally, sensitive and delicate skin requires garments that are soft and easy to care for.

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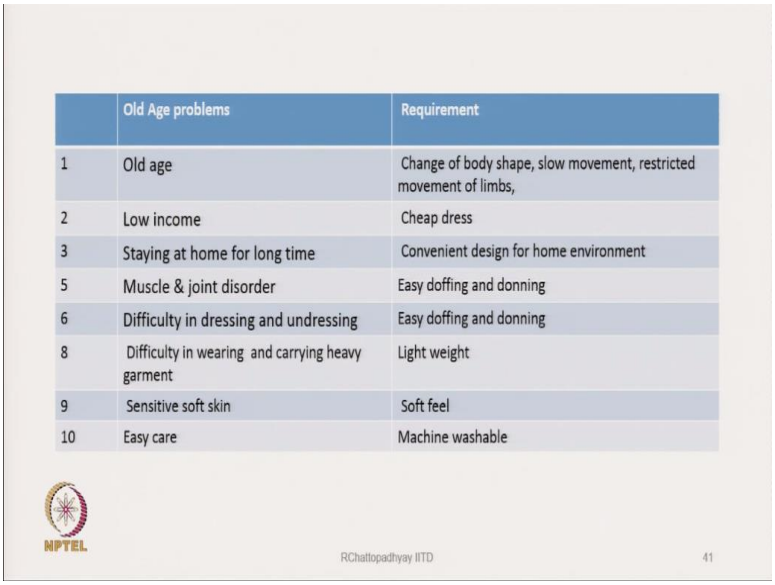

For these age-related challenges, we need to identify the key design requirements for clothing for older adults. As people age, their body shape changes, their movements slow down, and they experience restricted limb movement. Observing older individuals, it is clear that their body posture often becomes bent, their movements are slower, and their range of motion is reduced. Unlike younger individuals, they cannot stretch or move their limbs as easily, which must be considered when designing garments for them.

Older adults often struggle to lift their hands, arms, or legs as much as younger individuals due to restricted movement. This limitation affects all types of body movement. Another concern is the reduction in income after retirement, with many older individuals wanting to remain independent despite financial challenges. As a result, there is a need for affordable clothing that suits their lower income.

Since older adults spend extended periods at home, the design of their clothing should be convenient and suited for a home environment. This typically means casual, comfortable garments that are neither too tight nor restrictive. The design has to be convenient for the home environment. Additionally, with common muscle and joint disorders, the clothing should be designed for easy donning and doffing, making it simple to put on and take off.

Additionally, older adults often find it challenging to wear and carry heavy garments, so they should be lightweight. Reducing the weight of the garments becomes an important design consideration. Finally, the fabric must be gentle and comfortable for those with sensitive and

soft skin. A soft-feel garment is essential to prevent skin abrasion, as rough fabrics can cause rashes. Therefore, the fabric must be gentle on the skin. Additionally, easy care is crucial, meaning the garment should be machine washable, eliminating the need for hand washing. From a design perspective, the key problems older adults face and the corresponding design requirements are outlined here to guide the creation of suitable garments.

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The possible solutions for these requirements are listed in the table.

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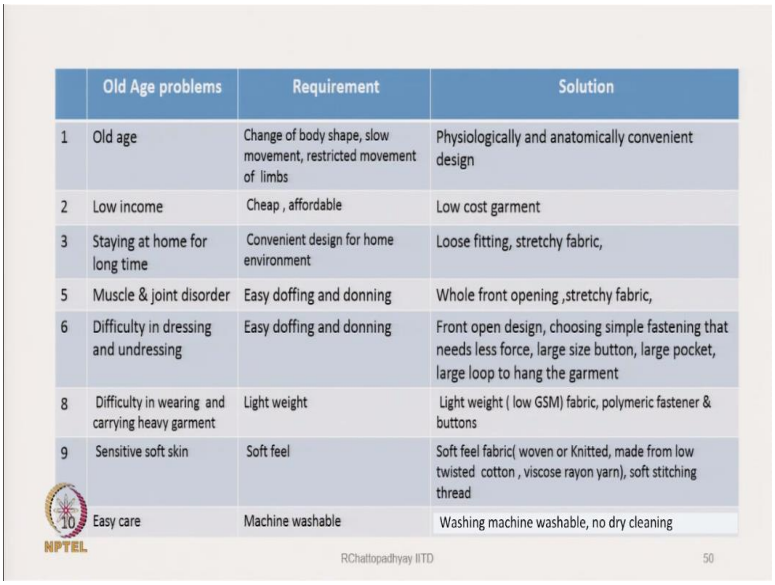

The first requirement is related to old age: changes in body shape, slow movements, and restricted limb movement. The solution lies in designing garments that are physiologically and

anatomically convenient, ensuring comfort and ease of movement. The next important requirement is affordability, meaning the garments must be cheap and accessible.

Therefore, the focus has to be on creating low-cost garments, ensuring they are affordable without compromising essential features. The solution should be economical. Additionally, for a convenient home environment, loose-fitting and stretchy fabrics are ideal. These allow comfort and ease of movement, making them well-suited for everyday wear. The garments should be designed for easy doffing and donning, ensuring they are simple to put on and take off.

To address these needs, a front-opening design with stretchy fabrics is essential. For easy doffing and donning, the design should include simple fastenings that require minimal force, such as large buttons, large pockets, and large loops for hanging the garment. These elements should be incorporated into the design. Additionally, lightweight materials are crucial, so choosing low areal density, i.e., low GSM fabrics and polymeric fasteners or buttons, is ideal, as polymeric materials are low-density and help reduce the overall weight of the garment.

Polymeric fasteners or buttons should be used instead of metals, as metals are heavy. Next is the requirement for a soft-feel fabric. This can be achieved with woven or knitted fabrics made from low-twist yarns, especially if using cotton. Alternatively, viscose rayon is an even softer option compared to cotton. Additionally, soft stitching threads should be used to maintain the overall comfort and gentle feel of the garment.

The soft feel of the product can be achieved by carefully selecting the fabric, fibre, stitching method, and thread type. Each element plays a role in enhancing softness. Additionally, easy care is essential, meaning the garment should be machine washable. It should be designed for easy cleaning in a washing machine, eliminating the need for dry cleaning. The fabric has to be chosen not to require dry cleaning. Certain fibres and fabrics require dry cleaning, so the design should focus on options that can be easily washed in a standard washing machine.

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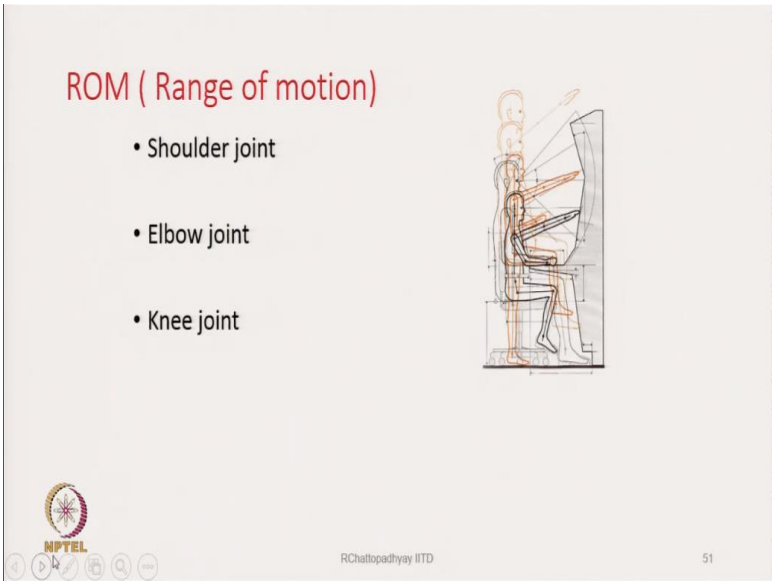

Another important aspect to consider in design is the range of motion (ROM). Understanding the range of movement capabilities of the shoulder, elbow, and knee joints is essential. By studying how much these joints can move during specific tasks and in certain postures, the garments can be designed accordingly. The clothing must be modified to ensure that it does not restrict the range of motion.

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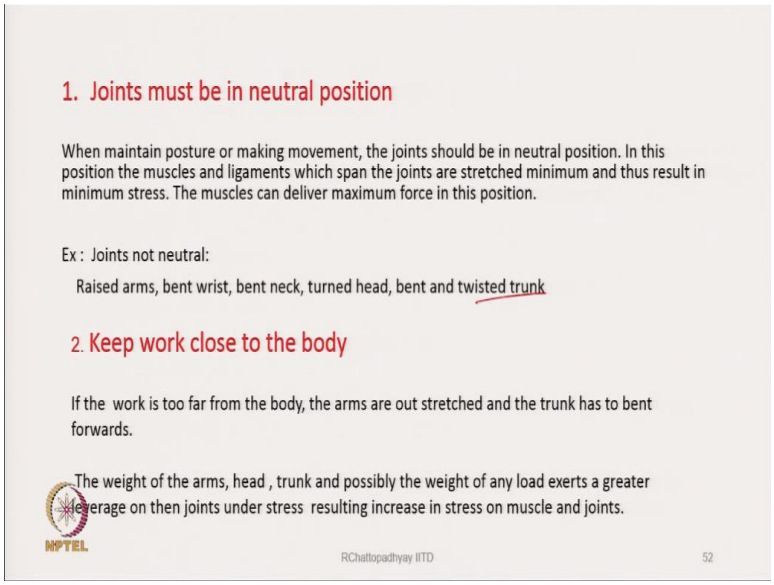

To ensure proper design, we must maintain the joints in a neutral position. When joints are in this position during movement or while maintaining posture, the muscles and ligaments that support the joints experience minimal stretching, reducing stress. This understanding helps in the design approach.

Muscles are capable of delivering maximum force when joints are in neutral positions. Examples of these neutral positions include a raised arm and a bent wrist. Conversely, positions such as a turned head or a bent and twisted trunk indicate that the joints are not neutral. If the posture changes while a person is doing a certain task, then the neutral positions of the joints get disturbed, leading to increased stress. Additionally, the garment itself can further restrict these movements.

Therefore, these aspects must be considered while designing, which is keeping the work close to the body. If tasks are positioned too far away, it forces the arms to stretch out and the trunk to bend forward. This is not desirable because a person's posture will be very strenuous in nature. This posture places greater leverage on the joints, as the weight of the arms, head, trunk, and any additional loads increases the stress on the muscles and joints.

The key point is that the weight of the arms, head, trunk, and any additional load can exert leverage on the joints. This leads to bending stresses and moments acting on the joints, resulting in stress development. Therefore, this stress develops in the joints, making the person feel tired very fast, or they will not be able to work for a long time.

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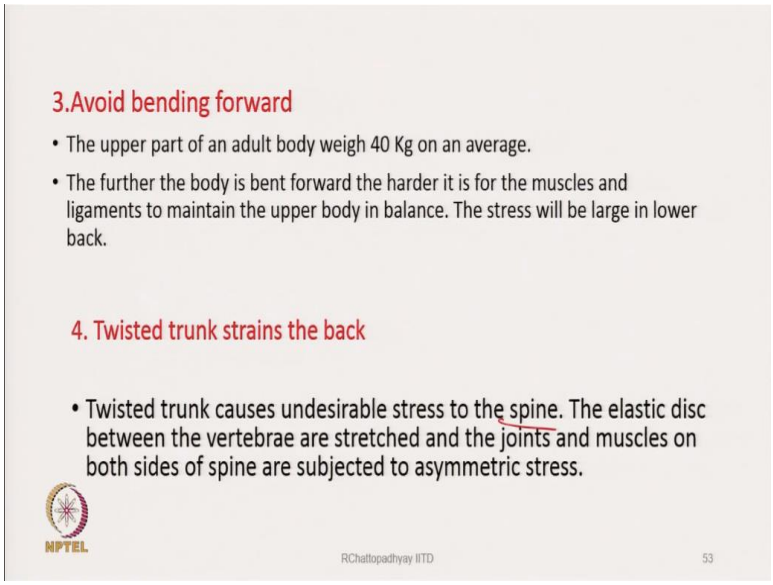

Another important consideration is to avoid forward bending. When designing textile equipment, machines, or machine parts, the primary consideration has to be the bending aspect

should be minimal. The more the body is bent forward, the more difficult it becomes for the muscles and ligaments to maintain balance in the upper body, leading to increased strain. These considerations are particularly relevant when designing machines or instruments related to textile activities, such as textile equipment or machinery. Another important aspect is to minimize trunk twisting, as frequent turning or twisting can strain the back. If the nature of the work requires frequent twisting of the trunk, it places additional stress on the spine, leading to discomfort.

The elastic discs between the vertebrae become stretched, and the joints and muscles on both sides of the spine experience asymmetric stress. Therefore, designs that require a person to twist their trunk, bend, or lean forward, backwards, or sideways should be avoided. Such movements can lead to strain, so it is essential to create equipment that minimizes these types of motions during work.

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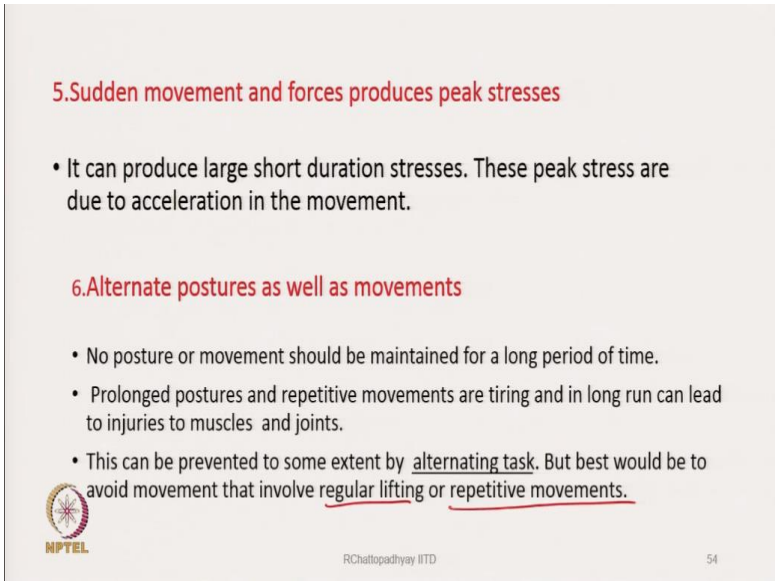

Sudden movement and forces produce peak stresses, resulting in large, short-duration stress on the body. This type of sudden movement is undesirable. The other one involves alternate postures and movements. No posture movements should be maintained for an extended period of time. It is important not to assign tasks that require a person to hold a single posture over a long period of time.

However, certain tasks require individuals to maintain a fixed posture for extended periods, leading to rapid fatigue and discomfort due to some kind of pain. For example, sitting at a desk

and working on a computer for long durations often results in poor posture, causing strain in the shoulders, neck, or spine. Therefore, some posture change is required in these cases.
Maintaining the same posture for extended periods is undesirable. Prolonged postures and repetitive movements can be tiring and may ultimately lead to muscle injuries. This can be prevented by alternating tasks so that posture can be changed. The best solution would be to avoid movements that involve regular lifting or repetitive movements of certain body parts. These are related to the ergonomics aspect of the design.

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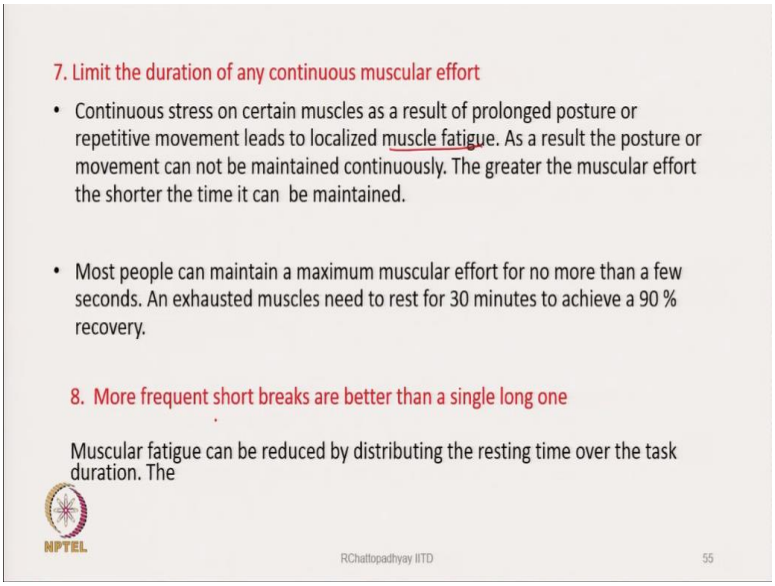

Another important consideration is to limit the duration of continuous muscular effort. Continuous stress on certain muscles, resulting from prolonged postures or repetitive movement, leads to localized muscle fatigue. Engaging in the same activity in the same manner for extended periods can result in fatigue. Therefore, it is essential to consider this when designing some objects.

Most people can maintain maximum muscular effort for no more than a few seconds, and exhausted muscles typically require about 30 minutes to recover to 90%. Consider the posture of handloom weavers who engage in repetitive tasks for extended periods. To improve the handloom design and minimize the stresses that can develop in the muscles or other body parts, we should explore features that promote better posture, reduce repetitive strain, and allow for more comfortable, efficient movements.

Such ergonomic studies are essential, as they can inform the redesign of handlooms, which are very prevalent in the country and involve many workers. Additionally, there are numerous other activities and occupations where individuals maintain the same posture for extended periods. In the Lucknow area, it is observed that women engaged in intricate chikan work, where they bend over, using a needle and thread to create beautiful designs on fabric. However, these workers often maintain the same posture for one, two, or even three hours, leading to significant discomfort and pain. So, all kinds of surface design using threads that people are involved in is very stressful.

To minimize stress levels in such work environments, it is essential to conduct ergonomic studies. Based on this research, redesigning tools or developing new equipment can be explored to help the worker in terms of improving efficiency and minimizing fatigue. Additionally, implementing more frequent short breaks is generally more effective than having a single long break. Reducing muscular fatigue is essential, especially for tasks that require specific postures.

To achieve this, it is important to encourage workers to take frequent short breaks rather than relying on a single long break. For example, allowing a 10-minute break every hour can help. This way, after each hour of work, they can rest briefly before resuming their tasks, promoting overall comfort and productivity.

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This concludes our discussion on ergonomics. Ergonomics is very relevant for the design of clothing and for the design of other equipment that the textile people involved or people who

are working in the textile arena may be involved in. Additionally, understanding anthropometry is vital for clothing design and equipment development, ensuring that products meet the needs and dimensions of users effectively.

When designing any product intended for human use, it is essential to consider the capabilities and dimensions of the human body. This includes understanding the sizes and proportions of various limbs to ensure that the design is suitable for users. People exhibit significant variability in their physical characteristics, including length, weight, thickness, and other body parameters, which must be considered during the design process.

When we consider any specific body part, its parameters vary significantly from person to person. These dimensions are highly distributed rather than fixed values. So, design cannot be done based on average dimensions. It is essential to create designs which will satisfy the maximum number of people.

To design gloves, the measurement of people's hands and fingers is needed, and accordingly, the design has to be made based on this size to suit a maximum number of the population. Therefore, small, medium, large, and extra-large sizes exist because of the diverse population distribution. So, it is impractical to have a single design that fits everyone. By offering multiple sizes, we ensure a better fit for a broader range of individuals. The population range is extensive, and therefore, divide the population into several groups, and a design can be created which will suit that particular group. Thank you.