Product Design and Innovation
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Lecture – 13
Cognitive and Emotional Aspects of Human Factors with Respect to Product Design and Innovation

Welcome biomechanics is whenever we are doing something or interrupting with some product may be a simple holding a pen or opening a tap we are exerting some force. So, what amount of force is required to operate some product or how much force can exert by a person or the user that is very important to know when you are designing some product. In this backdrop the information we require about the strength of the person.

Or force how much exert they can use that information we can get from biomechanics. So, in this discussion nearly we will discuss how it is relevant with product design and how we can get benefit using bio mechanics in our product.

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So, let us first run a video so here you can see one product that is a can opener and we have an can and if you see the product the person is trying to open the can and once he has done this once he has done this once he has clicked this can he locked it and then he is trying to rotate this thing throughout the edge of the can. That is the video we have seen here.

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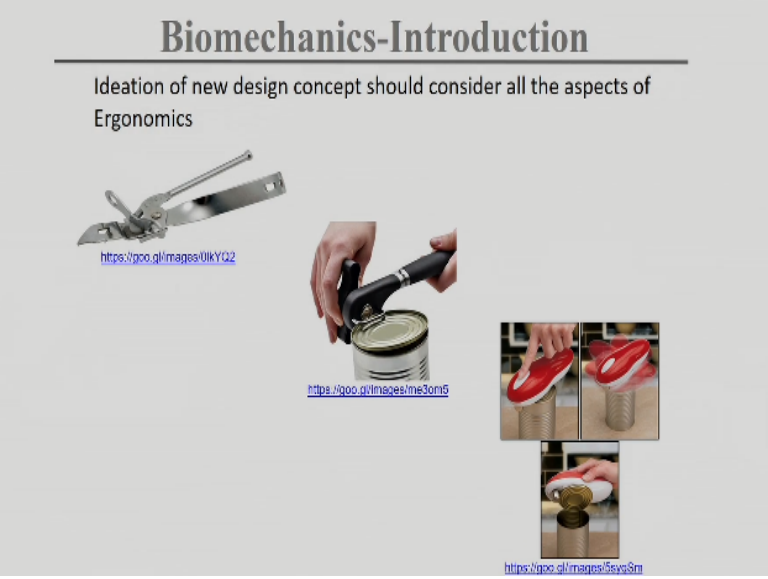

So, this is a very common product what we are usually seeing in our day to day activities and it is very useful to make our food and it is such a product where this product can be used by a person whose age is maybe 12, 13 years or adult person also it can be used by an elderly person, So, as you have seen these products when the person was using this product we needed certain type of force or rather a tool to operate this thing.

So, first he or she has hold this product and hold this part of this product and then he has twisted it and he has used certain torque because the circular object and then it has here revolved this around the edge of this can and finally this can got opened. So, if you think the range of the population so as it may be possible that a kid from a kid to an elderly. So, obviously the torque you need to generate here.

To open this can is obviously not same for the kid and the elderly person. So, we definitely we need to understand the information that how much one elderly person can exert or how much a kid can exert if that will be sufficient to open this can then only this product will be useful for a range of population. So, in this case first thing if we think of this thing physical interaction first this person is holding these things.

So, obviously this portion this dimension of this thing should be comfortable with the person

who is holding. And also this handle of the part should be very comfortable with the person who is holding this thing and also we are just rotating this thing and then you need certain force to revolve around this. So, in this type of case these are the biomechanical aspects we need to think of that is the information related to force how much they can exert.

Those information is very important and how much strength you need. These are information you require from the point of view of bio mechanics to design certain product. Now if you see this can opener that is an earlier one that is a classic can opener which is made of steel. If you can see this thing almost same thing in here it is a wing nut is there and you have to just rotate this thing and then this this can will got open.

But if you see compared to these products it is a steel made and the dimension it is very flat. So, it is not actually comfortable with the holding of this thing. If it if it is something circular, then it is very easy for us to hold it and properly grip it and then use that product which is very easy for this product. But in this case it is not very easy because it is a flat one also this wing nut thing to hold this thing and after that holding to exert certain force it is pretty difficult.

So, when you are designing and due to this form and material used and the shape of this thing will also influence the force and the exertion of the person. So, people will not be very comfortable and easy for use it is not very easy for use and efficient to use. If you think on the product redesign and innovation. So, when we are redesigning that product we can think of the form of this thing.

So, from there we can think of this form the material and how much easily it can be hold. And once you can hold it very easily then you can use it very efficiently. So, if you see this modification from here it is a more useful more user centered. Then if you see the latest product it is battery operated and here in this case only a switch is there which you can see here only once we press it will just cut this can and it is over.

And then you can press again this thing and it is it will be switched off. So, in this case as we have discussed about that load means performance load and we have discussed earlier that

performance load can be 2 types one is physical performance load and another is cognitive. So, in this case obviously the physical load is getting very much minimized because you do not need any force to exert any terms just only to click of a switch it reduced drastically.

And also it is very easy to use and it is nice to see so those things. Also one another very important point when we are designing any product is once you are taking of this thing what is remaining. In few cases if you see this product once its coming out of this edge is very sharp. If your product is cutting like this and your remaining is very sharp edge it may be very unsafe from the point of view of further use of this content.

So, once you are designing you have to understand the bio mechanics and the person, form what is the material, how it will be manufactured and how much force they can exert. Simultaneously you should think once you have used this thing whatever remaining portion is there how it will be safe for the person. Or how much user centered it is because if it is a very unsafe thing it can cause harm for those person.

Accident or injury may happen so in when we are designing something we should think before the tool how it will be designed how it will be used here and after using that product how safe it is so it should not keep any unsafe edge or this thing. So, this is briefly why we need bio mechanics and how it can be applied in a product. So, we have discussed one single product.

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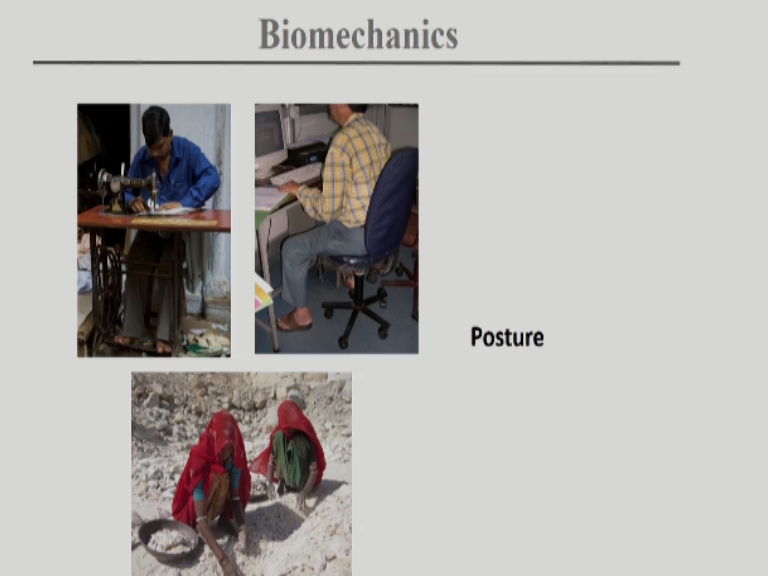

Now we will move to the overview of the biomechanics. It is a very common pictures we have taken it from 3 different workstations whenever we are doing something we need to adopt some posture as it is very obvious we have seen that when you are working for a longer time so we are feeling a bit pain and discomfort in our body. So, we change our posture and we are going for a one-minute break 2 minutes break again we are coming in like this.

So, but it is very important that how the posture will be so posture can be like this posture can be like this and like this also. Posture will very much dependent on the work or the product you are using how you are using. So, in these case if you see this product demanding this thing and also this person is adapting to make it more efficiently. In these cases, also this person is trying to view these things.

So, adapting such posture and also the height of the table chair is not comfortable enough so it can be of same height so there will not be this bending will happen. In this case some ladies are working in this case they adapt some squatting posture which is very difficult to sit for a longer time and they are adapting some posture. In this case their whole back is very getting strain and again they are doing something extending their hand and doing some activity.

So, depending on the posture they are adapting this biomechanical demand will be very different depending on their different work station different activity you are doing like this.

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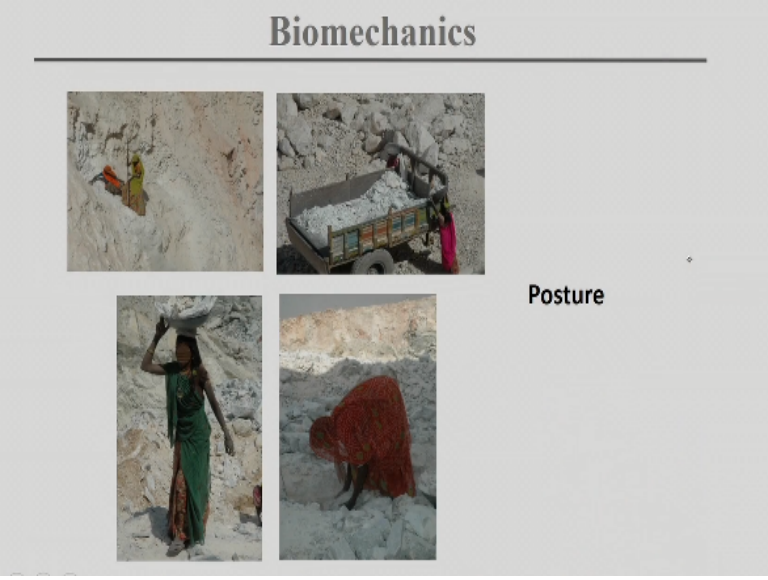

So, next when you are in motion in these cases what we have discussed in all these cases mostly these persons are in static condition. It is not fully static but mostly there is no such motion from one point to another. Now we will move to the next slide where the person is moving from one point to another or like this or he is lifting something some trolley or something. So, in this case what happen in this case.

Posture is also very important because in such condition if you take this thing this lady is adapting some posture to maintain his balance in this hilly condition and also she is using this shovel to take this stones out. So, he is using some force here and he is also maintaining his balance so things is far more complex than the person is sitting or standing in a plain land. Another thing when this lady if you see this thing.

This person is unloading some stone from the ground and she is putting this thing in this. In these case the person has a very load here and she is extending this thing top of her head and she is putting this thing here. In this case what is happening once this balance is very bad because the whole load is on the top of her head and also she is extending to reach this thing. So, once this reach will be far more extended then the ability of the person.

The posture will be very risky from the point of view of user. Another thing we can see here we

are seeing so many cases the person is holding some load and transferring from one place to another. This is one such condition this lady is walking from one place to another place carrying this thing. So, the way the person is carrying things are more whether she is putting on top of her head.

Or in one side or both side or on the back of her head or here maybe like a bucket holding in front here. So, these things is a very these issues are very important how the load has been carried by the lady and how it is influencing the posture depending on the load and mode of the load carrying the posture will be more complex or can be more risky and dangerous from the point of view.

Another thing is very important the amount of load another thing what is the frequency of the person or how many times she or he is doing the thing or what is the time duration these are the issues which can be very important criteria to understand the risk of the posture the person is adapting. This is another very common thing we are seeing the lifting of load so it is important what is the posture they are adapting when they are lifting a load.

If you have seen this thing so we can take another example when we are seeing the weighing machine so if you have certain load in this thing and here and here so and you can put some weight here if you can your fulcrum is here and if you are putting certain load here if this is =to this thing what will happen this thing will be here only there will be no movement in this side or in this side.

But if you put this load in this side what will happen this thing will come this thing will come here and this thing will be like this. So, in this case what will happen if you think of this load in this case this load is getting in one side. So, in this case this portion is getting bending down and this portion has to increase the strength this portion has to take the loads so that it can be lifted out from here to here.

So, this is a simple mechanics so if we use this thing in this case in this case the load is getting in one side and this portion of the muscle is getting more stressed to lift this load from ground to

top of her head. In this case what we say this maintaining on the posture and now awkward posture or the posture the person is adapting is very crucial. So, if it will be nearer to the body or the way the person is handling if it will be bended from the knee.

Then this will be more easier to lift the load. So, it is very important in case of any designing of product how far distance it will be this is how far distance it will be from the person. So, that it will be if we if the load is nearer to the axis of the body the efficiency will be more. If certain thing may be bucket or something you are holding like this if this is more like this shape it will be very difficult to hold and carry.

In that case if it is nearer to the body and if you cut this part then it will be more easier so when you are designing some product or object where it will be carried from one part to another something like this then we should take care of the shape of the object how it will be and how efficiently it can be carried taking care of the safety off the user.

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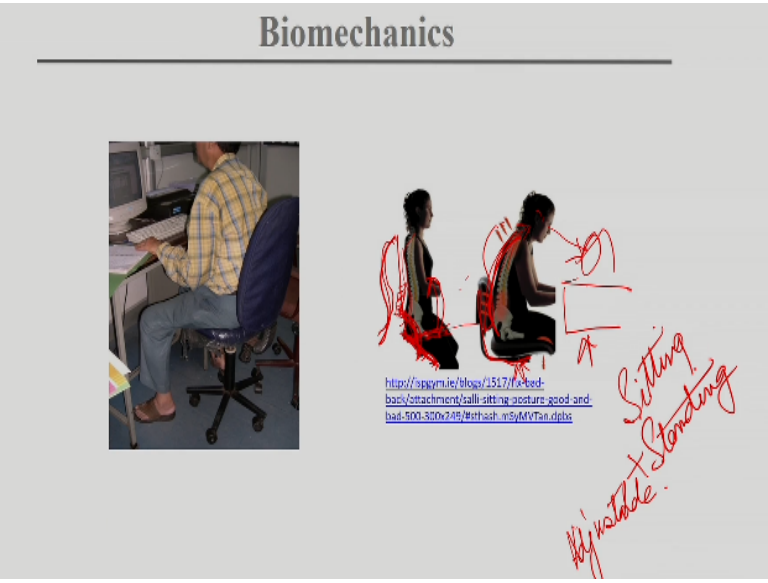

So, this is another example we are sitting in a place usually when we are standing our spinal cord is something like this a shape and we are preferring something chair or something where usually we have the support like this thing. But if you see when we are sitting for a longer time usually we are adapting so something like this posture. Because we cannot sit erect like this for a longer time.

So, if our chair is something like this usually we are getting our self-bending down and we are using this thing. So, in this case if you see the spinal cord become the C shape this is very risky and dangerous posture when the person is adapting. In this case if our work table is here or our monitor is something here then we are usually adapting this type of thing. But it is very important to keep our spinal cord like this shape.

So, if we want to correct our posture from this to this what we can do we can make it from sitting to standing condition. So, if we stand again it will be C shape but it is not possible to stand for a long time. So, what else we can do it can be something in between usually we are seeing chair something like this. So, it is not if you see this chair it is kneeling chair so in this case it is not a 90-degree thing it is this angle is like this it is more.

So, if you see this angle this is much more than 90, it is usually in our conventional chair we have seen something like this in this kneeling chair we have angle like this. So, in this case it is not actually standing but it is you have increased this angle. So, if we increase this angle this posture of this spinal cord will be again be S shape. So, how it matters to our product design so when are designing something work station work table modular furniture.

When we need to adapt certain sitting posture for a longer time we should think of something like this where we can adapt sitting, standing not only sitting or not only standing. We should think of both sitting standing conditions so the person will be able to sit stand both and also obviously the adjustability. So, if it is something some workstation that which will be used by many people so then we should think of the adjustment of the person.

So, that they can change the height and workstation height everything depending on the need of the person.

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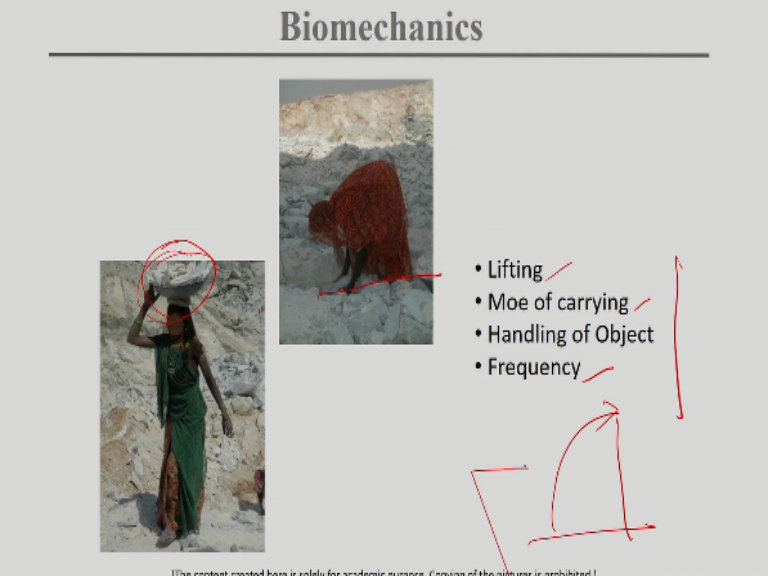

So, next we have discussed right now that what are the issues we should think when we are designing something what is the lifting what will be lifted mode of carrying we have discussed this how it will be mode of carrying, handling of the object how it will be handled and the frequency and another thing is the time. How many time so these are the few important factors when we are designing something like this object what can be handled.

Means it can be some very heavy object carton, or it can be something very barrel like this what will be transported from one place to another these things should be noted. Another thing how the person will bend so there can be some mechanism so this level will be minimized. So, if it will be raised from ground to here then it will be very difficult. But if some table or something is there and the load is here and the person is here.

So, obviously the load will be far more decreased than from taking it from the ground. So, obviously we can change the posture in this way to put something. So, when you are designing some furniture or this object we have to take care of these things it will depend on the how many times the person is doing. So, it is very important to understand the bio mechanical issues when you are designing something workstation this type of object all this.

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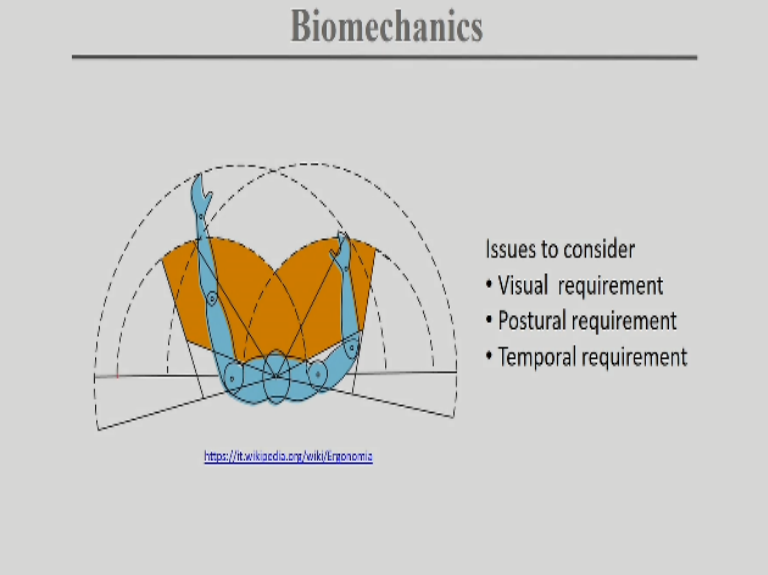

So, next very briefly so when we are designing this type of workstation or something what are the principles means what are the rather what are the requirements. So, first is obviously we have visuals so visual requirement is the first priority. So, when we are doing something may be aligning something or we are putting some fixture on some product. Then visual requirement is the first requirement we need to see what we are doing.

So, first is we should take care how the visual requirement will be fulfilled from the design of the furniture or work station. Next is the postural requirement posture what are the postures the person can head up for example if we see the customer care section or billing section with whom we are interacting our bill in electricity, telephone like this we are seeing the person is sitting and the person is taking the bill from us.

And he or she is scanning this bar code and everything and he is checking what is the amount then they are taking that amount from us and if there is balance they are giving you if they need something to scan or something take some changes they again rotate to some other corner table then they will take that grab that then they will take a printout may be for printer they have to rotate from if you take this thing may be they have to here the printer is here.

The main desk is there where their window is there here they are interacting with you and here it is the main computer is here and here you are there. So, what are the postural requirement

depending on the work they are performing. So, first is the visual requirement all these places should be very much visible to that person what are the posture level. So, if you see this type of thing the person need to rotate his spinal cord.

And he or she has to adapt this various posture in this step. So, we should think when you are designing modular furniture for this type of case we should think how this postural requirement, visual requirement and temporal requirement. So, we have discussed this time related to time how long the person is here. If the person if you are designing some furniture where the person will sit may be hardly for 5 minutes 10 minutes, then it is not that risky.

But if the person may be in office or something like that then the person may end up with posture may be for 7 to 8 hours or more. Then we should consider all these factors in first priority to design the whole furniture on the work desk. So, what is the principle now we can see from this picture. If we see this thing this is the person is sitting this is the top view and if you see the usually our hand from our elbow, we can rotate with our right hand.

This part this part is very easily we can access for same thing for left hand from with elbow we can use that posture. So, this is the most easy way how we can use usually we are not extending our hand to reach something. Whatever we want keep it very accessible we are putting nearer to us. So, when you are thinking something to put very nearer to your body when you are designing some furniture.

Where you know this person will use these products very frequently each and every time may be. So, then you put whatever is in this primary zone where the person can very easily fold it from the elbow every easily they can access this primary area. And also with both hands they can act if you see this part this part with both hands they can access. So, whatever is important you put use this part and whatever is may be very precisely you need to see and use both hand area.

May be you have to fix using both hand. Then you use this part and if you have to take something and put it something then you can use this area to put and then you move it to this part. So, this is the primary area next if we extend a bit this is the secondary area if your hand

will be extended if you see this is the next level priority second priority thing you can put like this so this is the secondary area same thing is from left hand.

Next is the treasury area what is dependent on the reach we have discussed about reach dimension in anthropometric. So, if you extend your full hand in this case this is the maximum reach you can have. For left hand this is the part and for right hand this is the part. So, what is less needed if you are designing if you see this from where we are getting the boarding pass. So, we have seen that workstation there there are some decorative item may be flower vase.

Or something you can put those thing here. Because this person is not using this thing randomly so put all these thing in treasury area what is the maximum reach of the person or more than that. But whatever they are accessing those things are in priority and we use this area. So, these are the basic principle how you can design a furniture depending on the person's activity performance what are the activity they will do.

And obviously we need to consider the visual requirement, posture requirement and temporal requirement.

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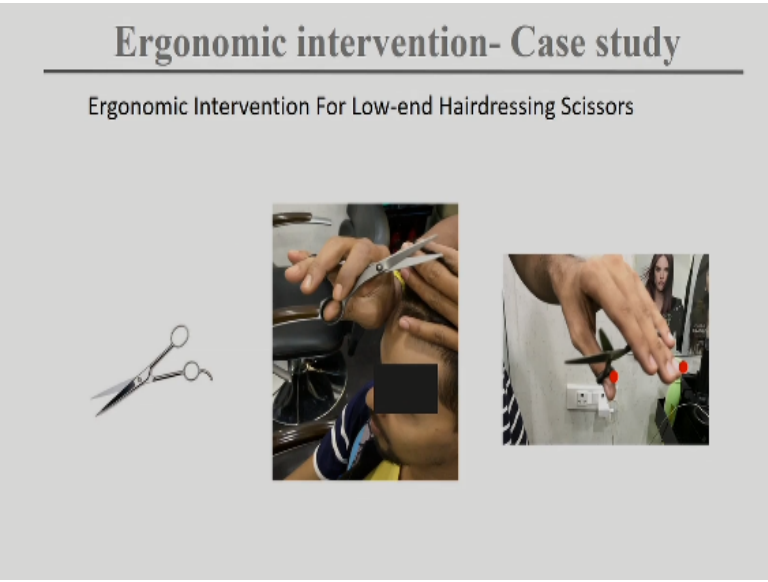

Now I am just going to a very brief case study so here this is a very common picture we are seeing in a hair dressing scissor. So, this is one example while we will discuss very briefly how

you can intervene your product. We have seen one example in case of can opener we will see another product how actually you can take the ergonomics principles how you can implement those ergonomics principles in your design.

So, this is one example of a hair dressing scissor or it is called shear and what this is one person is professional is cutting the hair if you see. So, if you see these thing they are adapting certain posture to hold the shear and use it efficiently. Also depending on the part of hairs they are cutting so they are changing the posture and the way they are holding that with hand, holding this shear.

So, in this case we have project we have first we have understood that how the person is existing condition with existing scissors which is this one how the person is adapting. In this case they are putting their thumb here and other finger is resting here. So, now with using the existing shear they are having some pain point here. These are the place they are having this red area they are having pressure and pain point.

They have pain and discomfort in this area and blister they are developing. So, because when they are adapting this posture as we have discussed the references like this. So, if you have some posture like this it is very easy to do whenever you will hold something we are adapting something very different posture. If you take this type of scissors you are adapting something posture like this.

If you are using some posture so obviously when you are feeling this thing it is very comfortable once you are changing this thing and you are exerting some pose here, you will feel pain and discomfort in this part very much and when you are doing this in a number of times in a day it is very difficult. So, how to correct this posture.

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If we can do this thing, then it is easy so now we have this thing so how to correct if we can do this thing this is easier so in this case what you have to do it will be something like this and it will be nearer to that.

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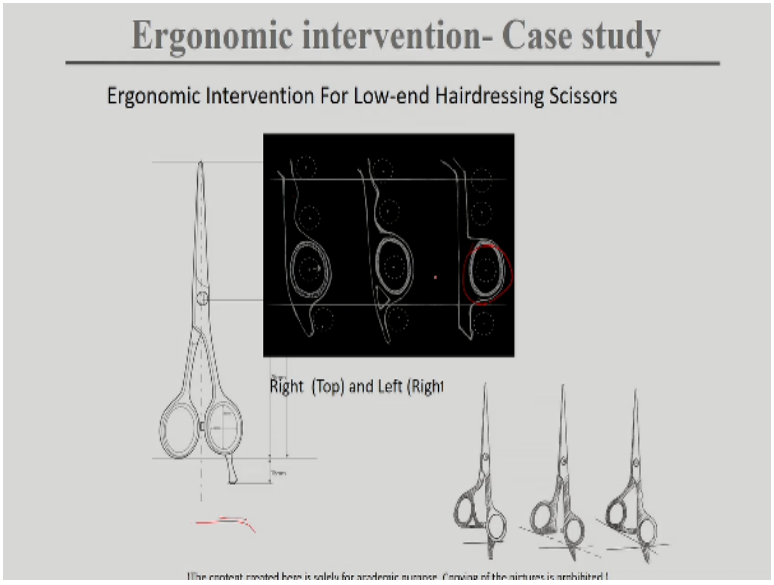

So, depending on that we have done some modification in this case. So, if you see this thing the existing shear is here so and this is a right eye hole of that thing that shear we have changed. So, if you see another very important point is where the person is resting their hand if you see the person is resting her finger this part but there is nothing is there. So, obviously it is that edge is hurting and for longer use they are controlling their hand.

So, it is pretty difficult to manipulate so in this case something can be there so that the person can rest their hand and also another thing to correct the posture if here we have done some modification in the left eye of the scissor. So, left eye has been changed so that this existing condition so this posture is something like this. So, in this case as we have changed for first thing this thing so here the person can rest very easily also we have corrected.

In this case as the both eye are in the same plane so it is you have to adapt your fingers with this scissor here we are considering the neutral position we have corrected the position now it is not in a same plane. So, as we have changed to this thing so if you see this thing from there we have tried to adapt this shear with the natural position or the neutral position on the hand trued to correct how much ever it is possible.

Obviously once you are doing this thing first thing due to this part the person can rest their hand it is easier to do comfortable work and with these changes when we are modifying this angle by that thing we are changing also the angle of the person how they are holding from there it has come like this so how they are holding this scissor. How you can correct the posture.

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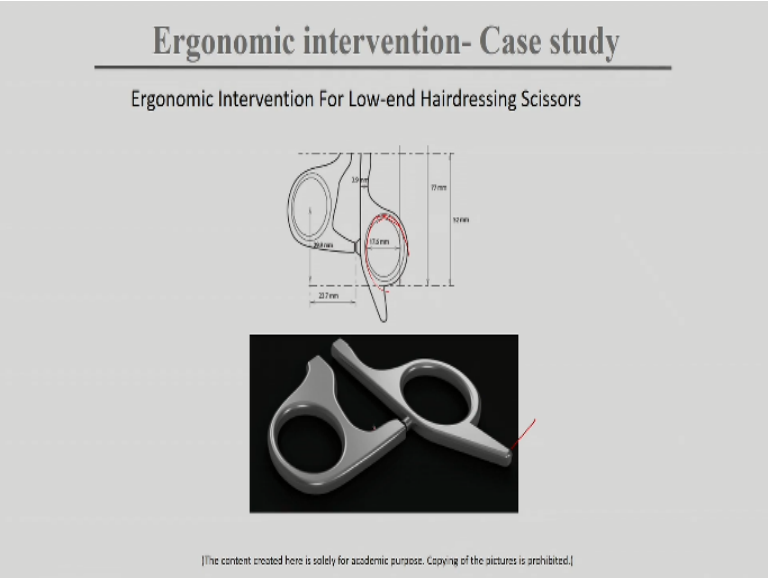

How you can implement the bio mechanical issues in your product design. Finally, this is the rendered product you can see here you can see here these are the dimension because this dimension also if you see the first thing in each of this case it was rounded. So, as it is rounded

so the person was having some problem to hold it. So, now also we have changed the eye hole of the scissor.

So, by this thing with the final product we have corrected few things one is the pain point it is more comfortable because they are getting the support and also we have taken the ergonomics intervention from the point of view of biomechanics and we have tried to modify or redesign that thing taking care the biomechanical issues of the person. So, this is one example how we can just to show you how we can take biomechanics importance of biomechanics and how we can use these biomechanical issues in our design intervention, thank you.