Independent mobility in prone lying

Oxford University Hospitals NHS
NHS Trust

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Assessment

The client presented in a front wheel drive Balder powered wheelchair with powered seat riser and powered height adjustable foot plate. She has a pronounced kypho-scoliosis at the mid thoracic level and is able to walk with support and transfers independently. She cannot sit independently upright due to weakness and cannot tolerate pressure to her back.

Our client has Spinal muscular atrophy and diastrophic dysplasia.
Spinal muscular atrophy is a genetic disease that causes muscle weakness and progressive loss of movement
Diastrophic dysplasia is a disorder of cartilage and bone development. Affected individuals have short stature with very short arms and legs. Most also have early-onset joint pain (osteoarthritis) and joint deformities which restrict movement.

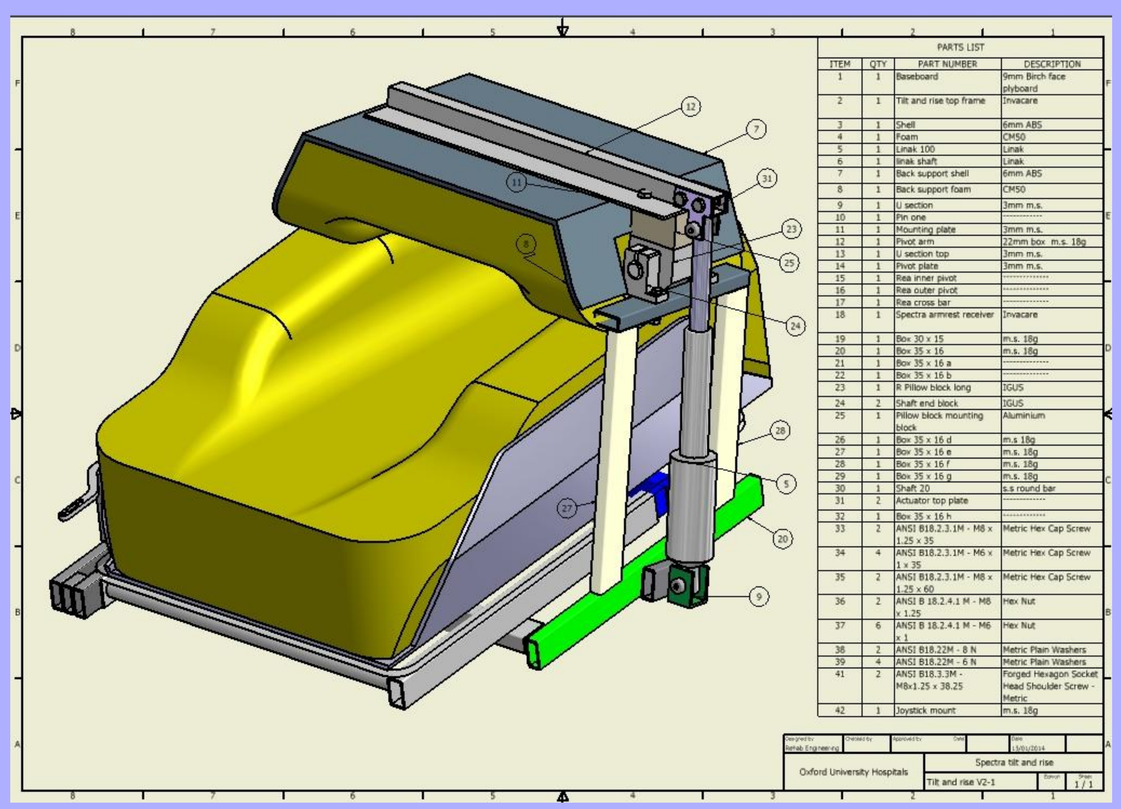
Initial trial

Our primary aim was to enable our client to operate a powered wheelchair in a raised and tilted position allowing improved comfort, respiratory and digestive function. Maintaining independent access to the mobility system and use of public transport was also required.

A Spectra Plus with rise and tilt functions was chosen and a lying surface was cut in CM50 foam on our 3-axis CNC milling machine. A moulding was designed to fit around the lower back and upper legs to hold her in place. A mounting system, incorporating a 400N Linak actuator with 100mm vertical lift, was developed to allow access. The first iteration of the design required the client to access the system from the front of the chair, turning on the "seat" and wriggling back into position before lowering the posterior support to hold them securely. As this proved to be difficult it was decided the client should access the "seat" from the rear.

Revision of Design

The system was re-designed using the same actuator moving the posterior support up through an arc in order to allow unimpeded access from the rear. The actuator function was programmed to be operated from the REM24 joystick as were the tilt and rise functions. The system utilised the standard DX power module and DX-CLAM.



Second trial

Much discussion centred around the length of the existing Balder wheelbase and the fact that she could not be accommodated on buses in West Oxfordshire. She stated that she would prefer to transfer sideways and forego the step mechanism.

Handover

An hour long test drive was undertaken to ensure the system was suitable.

Review

While the handover appeared to be a success a subsequent review revealed a number of issues. Operation of the tilt, rise and posterior support actuators required the operator to press the joystick to one side in order to change modes and then forward or back to change position. This proved to be to difficult to use so the control unit was changed to a G90 with two Spec switches fitted. It was programmed to have minimal functions displayed.

The posterior support was comfortable to use and provided effective security even in full tilt. She found that the mechanism closed too rapidly and would prefer that it was slowed down. This will be achieved either by fitting an external resistor to the actuator circuit or by changing the DX-CLAM to a DX2-ACT4 where the actuator speeds can be adjusted in the programming.

Conclusion

The project has used a number of skills available to us at the Oxford Centre for Enablement. The need for an unusual solution was identified at an early stage at an Oxfordshire Wheelchair Service clinic. The Rehabilitation Engineering Department realised the design and manufacture of the final actuator mechanism using a 3D solid modelling system and in-house fabrication. Static stability testing was conducted at a relatively early stage with the seat fully raised and tilted back, confirming the system to remain stable beyond 16 degrees with respect to rearward stability and in excess of 12 degrees with respect to lateral stability. Basic dynamic testing was carried out, using weights to simulate body mass, by driving the chair around a range of obstacles.

Clinical Team
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