

## Background

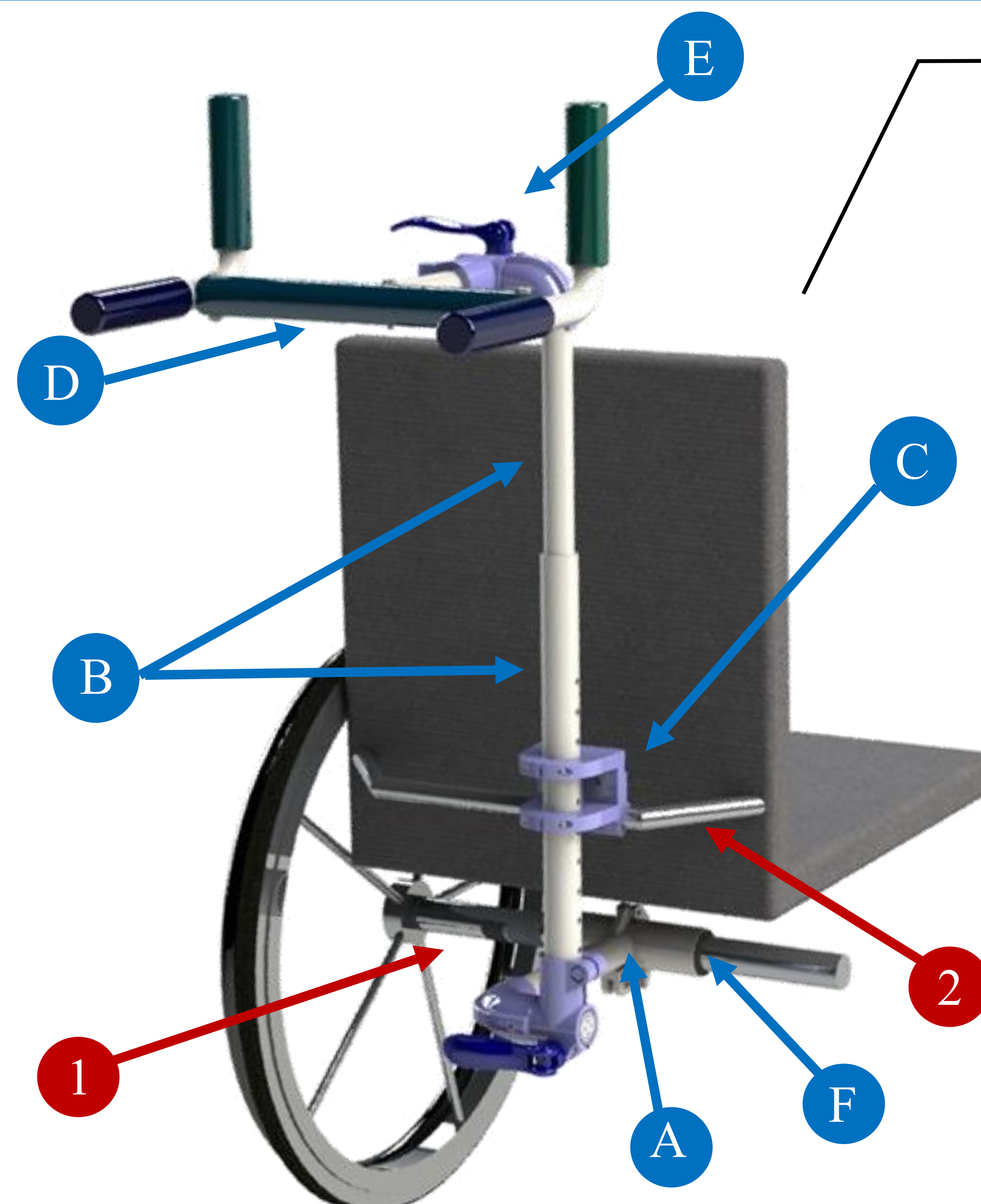
- Permanent wheelchair users typically use rigid frame wheelchairs because they are lighter and easier to control than more conventional folding frame wheelchairs.
- A large amount rigid frame wheelchairs do not have push handles, and the ones that do cannot typically be adjusted.
- The inability to change the height of the push handles often causes discomfort and in some cases injury in caregivers.
- The client identified a need for a set of easily detachable, position adjustable wheelchair push handles for rigid frame wheelchairs.

## Design Process

- Interviews with key stakeholders such as members of a wheelchair research team and technicians were used to develop the design requirements.
- Research into existing patents and commercial products was done to ensure originality of the final design concept.
- Three preliminary designs were developed and presented to the client.
- Design team worked collaboratively with the client to evaluate the design concepts and arrive at a final design which clamped solely to the **camber tube 1**.
- Preliminary testing revealed that two connection points on the wheelchair frame were necessary to perform all common wheelchair skills. This discovery led to the addition of clamp that connects to the **rigidizer bar 2**.
- FEA was done to find points of high stress and deformation

## Requirements

- Caregivers between 5'2" and 6'2" must be able to perform common wheelchair skills with a straight back.
- Should take no longer than 10 minutes to set up the device, and no longer than 15 seconds to detach it.
- The product must be able to withstand the stress due to the maximum load of 400 N with a safety factor of 2.
- Largest dimension of each component must be less than 50 cm so that the device can be stored in a knapsack.
- Entire device must be lighter than 6.5 kg.
- The prototype must cost less than \$500 to manufacture.
- Device must be able to attach to all rigid frame wheelchairs with rigidizer bars.



## Design Features

- **A Camber Tube Clamp** – hinged to allow for rapid assembly and disassembly of the device.
- **B Telescoping Tubes** – allows the device to be easily and quickly adjusted to the caregivers preferred height.
- **C Rigidizer Bar Clamp** – prevents rotation of device and is hinged for rapid assembly and disassembly.
- **D Handles** – designed to allow caregivers to maintain optimal wrist positioning through any common wheelchair skill.
- **E Adjustable Joint** – allows for rapid vertical height adjustment for optimal positioning during certain skills.
- **F Plastic Inserts** –allows the device to be mounted to wheelchairs with various camber tube diameters.

## Testing

- A trained caregiver was able to successfully perform common wheelchair skills, while maintaining better posture in comparison to performing the skills without the device.
- The joint used in the adjustable joint was damaged during testing which caused the clamp to fail.
- Testing revealed that the current prototype rattles too much to be used with confidence by a caregiver
- Design satisfied all dimensional and weight requirements.

## Recommendations

- Replacing the set screws used in the 90-degree elbows with bolted connections to eliminate rattle in the handles.
- Replace the pinned telescoping tube system with a clamped telescoping tube system to further reduce rattle.
- The camber tube clamp is to be re-machined with more care, leaving space for the nut to clamp it shut.
- Intermediate tubes should be made from steel, instead of aluminum in order to decrease wear of the material.

## References

- Kirby, L. (2020) *Handbook for Caregivers of Manual Wheelchair Users*
- Team 2, (2021) *Wheelchair handles testing plan.*
- **Special Thanks:**
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## Posture is improved with the device mounted

