The manufacturing of a tooth-borne oral device for a quadriplegic

John Edward Viljoen
Peninsula Technikon

Recommended Citation
http://dk.cput.ac.za/tygerberg_ds/19
The manufacturing of a tooth-borne oral device

for a quadriplegic

John Edward Viljoen, B-Tech: Dental Technology
Peninsula Technikon, Cape Town

Summary:

In dental technology one is required to carry out advanced technological and intellectual tasks that involve more than just the application of existing knowledge. In this specific case a quadriplegic requires an aiding device to facilitate her in the use of a computer. Due to the specific patient requiring such a device, and the dentition being a well-understood concept in dental technology, the case was therefore relevant to the field.

Patient history:

The specific patient for whom this aiding device is made is a twelve-year-old female who has been diagnosed with Guillian Barré syndrome, which causes paralysis from the neck downwards. She is thus a quadriplegic, and she is a permanent resident at the Tygerberg hospital.
More on Guillain Barré syndrome:

Guillain Barré syndrome is a syndrome and not a disease, which means there is no specific cure for the syndrome. The attack of the syndrome is directed at the myelin, which is the key insulation component of the nervous system, therefore making it a viral infection.

The syndrome affects 1 in every 100,000 people, and it is not directed at any specific race, gender or age group. This specific viral infection does cause paralyses of the limbs and chest area, but there is a 75% to 90% partial or total recovery rate, but in this case the paralysis is indefinite.

Patient condition:

The patient requires an appliance, which makes use of head movements to guide the appliance to facilitate her with the use of a computer. She is a quadriplegic with limited movement of her head, and she is permanently connected to a respirator. She is a twelve-year-old girl meaning that her dentition is still changing constantly. Her masseter muscles are also particularly weak, making the fabrication of a tooth-borne appliance difficult. Due to the fact that her permanent dentition is erupting, the appliance would have to be replaced regularly. This problem is overcome by fabricating an appliance with the mechanical part removable from the tooth-borne part, allowing the mouthguard to be replaced when necessary.
Background:

The patients’ previous appliance was fabricated by an occupational therapist (Fig. 1). In order for this appliance to be retained, and work to its fullest potential, it had to be retained by constant biting forces. The appliance was fabricated from hard plastic material consisting of a bite plane used to retain the appliance, and a straight rod exiting the mouth, which operated the keyboard. Due to the fact that the appliance had to be retained by constant biting forces, it placed allot of trauma upon her weak masseter muscles, resulting in the appliance being unsuccessful.
Possible treatment options:

There are 3 possible treatment options for this specific case, they are:

1. **Tooth–borne oral device**: This is a tooth-borne device with a mechanical rod fixed to a mouth-guard, exiting the mouth in order to operate a keyboard (Fig. 2).

![Fig. 2. A tooth-borne oral device prototype with mechanical rod fixed to occlusal surface of mouthguard.](image)

**Advantages of this device include:**

1. No biting forces are required for this device
2. It is inexpensive to fabricate
3. The device is simple to use.
4. Occlusal forces are equally distributed throughout the device

**Disadvantages of this device include:**

1. The length of the device can't be altered by the user
2. **Telescopic oral device:** This is a telescopic mouth instrument, which is held in position between the teeth, which gives a large working range from the mouth. The telescopic instrument is completely self-contained with toggle and push-button switches, or sub miniature micro switches (Fig. 3).²

![Telescopic oral device](image)

**Fig. 3.** An electronic mouth instrument with telescopic capabilities.

**Advantages of this device include:**

1. The length of the extending mechanical rod can be altered
2. No biting forces are required in order to retain the device
3. The patient is self-supporting when using the device²

**Disadvantages of this device include:**

1. The device is heavy in mass
2. The device is difficult to fabricate and use
3. The devices is expensive to fabricate
4. These type of devices require maintenance²
3. **Extra oral chin cap:** This is a chin cap, which is secured with straps around the head. A rod extends from the chin cap operating the keyboard (Fig. 4).

![Fig. 4. A chin cap secured to the patient by the use of head straps.](image)

**Advantages of this device include:**

1. It is easy for the patient to communicate with this device
2. It is easy to keep this device clean

**Disadvantages of this device include:**

1. It is uncomfortable for the patient to wear
2. The user has no independence when making use of this device, and therefore another person has to put the device on and remove it after use.
Most suitable and chosen treatment option:

The mouthstick device

Reasons:

1. It is inexpensive to fabricate this device.
2. The device is simple for the patient to use
3. The device is easy to fabricate
4. It is also not necessary for the patient to extend or retract the device

Laboratory procedures:

Impressions were taken from the special trays, which were fabricated, and models were then cast.

Plans were then drawn up for the special mechanical parts and these plans were then taken to Omnipless engineering company where the parts were manufactured.

These parts were all made from anodized aluminium, due to the fact that the metal is light in weight, and corrosion resistant. The fabricated parts consist of an extra-oral mechanical rod, which is approximately 30 cm in length, with a 130° anterior bend 10 cm posterior to the anterior tip. A magnetic tip was incorporated in the tip of the rod for the various tips to snap into position.

A special U-bar was fabricated which screws into the posterior side of the rod, which in turn attaches to the gum-guard. Various tips were then also fabricated for the patient in order to accommodate her in various tasks such as typing, drawing, and painting (Fig. 5.)
Fig. 5. Custom made aluminium tips made to facilitate patient in various tasks such as typing, painting and drawing.

These tips are also made from aluminium, but has a miniature stainless steel disc incorporated within the tip in order for the tip(s) to snap into position when making contact with the anterior, magnetic, part of the mechanical rod.

Two-ply gum-guard material is then applied to the maxillary model, by the use of an erkopress thermo-vacuum machine. This gum-guard material is a thermoplastic material, which means that is softens upon heating, and hardens upon cooling. The gum-guard material is then trimmed to the deepest part of the sulcus as indicated with red in the photo below.

Four holes are then carefully drilled into the U-bar, and special Dentaurum screw-sleeves are placed.

The U-bar is then further secured to the gum-guard material by the use of orthodontic acrylic, which is applied into the interproximal surface found between the gum-guard and the surface of the U-bar. It is then finished by pumicing and polishing the device in a conventional manner (Figs. 6 and 7).
Fig. 6. The finished device with the U-bar and extraoral mechanical Rod secured onto gum-guard.

Fig. 7. Patient typing on keyboard with finished appliance, and tip secured in place by magnetic tip.
Conclusion:

The construction of a tooth-borne oral device with a magnetic anterior tip to facilitate a quadriplegic in the use of a keyboard has been described.

In conclusion, taking part in tasks involving more than just the application of existing knowledge could contribute to the help of other people with disadvantages, capable of being reduced or eliminated by such participating individuals.

References:

