Measurement of Bone Thickness in Baha: How we do it?

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DOI: 10.29322/IJSRP.8.4.2018.p7646
http://dx.doi.org/10.29322/IJSRP.8.4.2018.p7646

Abstract- Bone anchored hearing aid is used for hearing rehabilitation in those patients with conductive or mixed hearing loss who cannot be benefitted with a traditional air conduction hearing aid. The success of the implant depends on its osseointegration with the scalp bone which in turns depend on quality and thickness of the bone, that has to be more than 2.5 mm. Here, we suggest an innovative technique to measure bone thickness both pre-operatively and intra-operatively. High resolution computerised tomography of the temporal bone is performed during the pre operative work up of the patient to determine bone thickness. It is measured behind the temporoparietal suture line.

In this article we suggest an innovative technique to measure bone thickness both pre-operatively and intra-operatively.

II. Procedure

We describe a novel way to measure skull bone thickness pre-operatively in patients with congenital external ear deformity to locate the most appropriate site for Baha implantation.

Our patients with bilateral congenital microtia with bilateral moderately severe conductive hearing loss along were posted for Right sided Baha implantation surgery. Head was shaved pre-operatively four finger breadths above and behind the malformed ear. Orbitomeatal line was extrapolated to approximately 6.5 mm behind the pinna thereby leaving space for pinna reconstruction in the future and site was marked and button cell was put over it. (Figure 1) This was kept in place using transpore. High resolution computerized tomography was performed with this in place. Axial and coronal cuts of the scan were reviewed to measure the bone thickness behind temporoparietal suture line. The site of artefact produced by the button cell was also noted. (Figure 2) The bone thickness corresponding to the site of artefact was noted and considered during the surgery for the implant.

At the time of surgery, while drilling hole for implant with the guide drill, we used measuring rods of different sizes 2mm, 2.5mm, 3mm, 3.25mm, 3.5mm and 3.75mm to assess the bone thickness intra-operatively. These are custom made by us to measure the depth of the hole intra-op, thereby indirectly measuring the bone thickness. (Figure 3)

Whenever we found the bone thickness was more than 3mm the spacer was removed and 4 mm drilling was done.
III. DISCUSSION

Baha is a percutaneous implantable hearing aid and depends on the concept of both osseointegration and bone conduction hearing. It consists of implant which is known as fixture, transcutaneous abutment and sound processor. The fixture usually comes in two sizes of 3mm and 4mm and the selection by the surgeons is dependent on the bone thickness and quality of the bone at the site of implantation.

Bone quality in children differs from the adult in many ways. Children usually have a soft bone due to low mineral content and high water content. U.S food and drug administration recommends Baha in children more than 5 years of age as minimum bone thickness of 2.5 mm is necessary for fixture placement. Younger children are provided with Baha soft band which is attached to the processor which allows for early stimulation of the cochlea and further speech and language development.

The skull thickness in children with congenital external ear deformity can be a considerable factor hindering proper placement of Baha implant. As we know that skull thickness of at least 2.5 mm is needed if a 3mm long fixture is to be placed. If the bone thickness is more than 2.5 mm then fixture placement, abutment insetting and soft tissue reduction is done in the same setting called as Baha FAST. Otherwise, surgeons go ahead with a two staged Baha surgery where in the first stage only the implant and with cover screw are is placed and abutment is placed in the second stage after removing the cover screw. The thickness of the bone not only decides the size of the fixture but also whether the surgery can be done at one go or needs staged procedure.

In one of the studies by Tjellstrom in 2004, they measured the skull bone at the site of Baha implant and variations in the bone thickness were observed in children as well as in adolescence. The average thickness at the 5 years of age came out to be just 2 mm. Also they observed that during surgery, the dura of the middle cranial fossa was exposed at the floor of drilled guide hole in more than 25 % of cases, which means we have to be extremely careful during the surgery in order to avoid devastating complications such as dural tears, subdural haematoma, cerebrospinal fluid leak, bleeding from sigmoid sinus. Meticulous placement of the implant at the correct site avoids extrusion of the implant. Hence, we recommend measurement of bone thickness pre operatively and intra-operatively. Use of button cell artefact in high resolution computerised tomography of temporal bone is a simple and effective technique to choose the site of implant placement pre-operatively and use of depth gauge intra-operatively. In our series, it has helped us avoiding multiple drill holes.

Acknowledgement: None
Disclosure of potential conflicts of interest: None of the authors have any conflict of interest
Ethical approval: All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.
Informed consent: Informed consent was obtained from the patient included in this study.
Role of funding source: None

Figure legends
Figure 1: Showing button cell placement at the possible site of implant before HRCT temporal bone
Figure 2: Axial cuts of HRCT temporal bone showing site of artefact produced by the button cell
Figure 3: measuring rods of different sizes 2mm, 2.5mm, 3mm, 3.25mm, 3.5mm and 3.75mm to assess the bone thickness intra-operatively. These are custom made by us to measure the depth of the hole intra-op, thereby indirectly measuring the bone thickness.

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