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Triamcinolone Injection for Cochlear Implant Magnet Adherence Issues

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Abstract

Objectives: To evaluate the effectiveness of triamcinolone injections in treating external magnet displacement in cochlear implant (CI) patients with adhesions problems of their processor.

Patients: We present seven CI patients with magnet adhesion issues who presented to our tertiary care neurotology clinic. None of the patients had a history of head trauma, post-implant MRI, or surgery in the head and neck other than the cochlear implantation.

Intervention: Triamcinolone 40mg/mL injected subcutaneously at the CI magnet site.

Main Outcome Measure: Reduction of scalp thickness and successful magnet retention.

Results: Our cohort consisted of 7 patients (8 implant sites) of which 5 were overweight or obese. The temporoparietal scalp thickness measured on preoperative CT scans varied between 8.4 mm to 15.9 mm. Initial conservative measures such as hair shaving at the magnet site, using a headband, and increasing magnet strength failed in all patients. After receiving triamcinolone injections at the cochlear implant receiver site, 6 out of 7 patients (7 out of 8 CI sites) were able to use their processor again without the need for a headband for an average of 9.55hrs/day. The average number of injections required for each patient was 2.57 (SD 2.18); median (range) = 1 (1–7). One patient required a flap thinning surgery but showed no improvement even after flap thinning. None of the patients showed skin irritation, breakdown, ulceration, necrosis, or magnet exposure during follow-up period.

Conclusions: The significant improvement in cochlear implant retention shows that triamcinolone injections are effective in making the subcutaneous tissue thinner and allowing magnet retention.

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Keywords

Cochlear implant; magnet; triamcinolone; skin thickness

Introduction

Since their development in 1960s, cochlear implants (CI) have been used to treat severe to profound bilateral sensorineural hearing loss (SNHL).[1,2] The external hardware of the CI contains the microphone, sound processor, and transmitter, while the implanted part consists of the receiver coil, stimulator, and multi-channel electrode.[3] Both the external transmitter and the internal receiver coil contain a magnet that guarantees the placement of the transmitting coil over the receiver coil and the transmission of electrical signals.[4] Thus, weak magnet strength and thick skin flap overlying the receiver coil may pose a retention problem for CI patients.

Patients facing retention problems with an off-the-ear (OTE) processor usually switch to a behind-the-ear (BTE) processor. If retention issues persist, patients should consider shaving their hair or wearing a headband. Finally, if conservative treatments fail, skin flap reduction (SFR) surgery should be considered. However, SFR is associated with bleeding, infection, necrosis, delayed wound healing, and risk of abscess and hematoma formation.[5] One alternative to decrease skin thickness could be subcutaneous triamcinolone injections (TI) to the magnet site (Figure 1). Triamcinolone is the preferred corticosteroid for intralesional injection due its high insolubility and ability to form microcrystalline suspension, which allows a long-lasting effect. However, its subcutaneous injection can lead to skin atrophy in 0.5 to 40% of cases. In fact, the formation of triamcinolone crystals in the vasoconstricted vessels results in tissue hypoxia, decreased collagen synthesis, and involution of subcutaneous fat lobules.[6] Although TI have been used in dermatology and plastic surgery, there is currently no published data on its use in otolaryngology.[6,7] Therefore, we aimed to evaluate the effectiveness of TI in treating CI patients with magnet retention problems.

Case series

After Institutional Review Board approval, seven CI adult patients (8 CI sites) who presented to our neurotology clinic with magnet retention problems were included. The following demographics were recorded for each patient: age, sex, body mass index (BMI), pre-operative skin thickness, history of trauma or head MRI, type of CI and processor, and magnet strength (Table 1). None of the patients had a history of head trauma, post-implant MRI, or surgery in the head and neck other than the cochlear implantation. To determine the temporoparietal scalp thickness, we used the method described by Searle *et al.* (Figure 2).[6] Patients received 0.3–1.0cc of 40mg/cc triamcinolone, subcutaneously at the CI magnet site. In case of insufficient response (patients 3,5&7), they received additional injections at 4 weeks intervals with small increases in dosage (0.5cc in patients 3&5 and 1cc in patient 7). The average number of injections required for each patient was 2.57. Seven implant sites (patients 1,2,3,4,6&7) were able to successfully retain their processors for an average of

9.5hrs/day. On physical examination, there was no sign of erythema, skin breakdown, or magnet exposure during the follow-up period.

Patient 1

A 25-year-old patient, who received his left CI24M in 2000, presented to our clinic for magnet retention issues. Since he started gaining weight, he had not been able to wear his BTE processor, even with magnet strength of 6, for more than 1.1hr/day. On examination, his implant was covered with hypertrophic scar. He received 0.3cc TI subcutaneously at the coil site in a fanned-out fashion. At 6-month follow-up, the injection site showed thinning and the patient was able to wear his BTE processor for the entire day.

Patient 2

A 76-year-old patient with a history of bilateral SNHL and Synchrony CI (left CI in 2015 and right CI in 2019) presented with poor magnet retention on the right. On examination, we noted thickening over the right magnet site. Therefore, the patient received 0.3cc TI. Since a month post-injection, he has been wearing his right BTE processor for 14hrs/day.

Patient 3

A 29-year-old patient, who received his left CI24M in 1996, presented for CI retention problems after gaining weight over the year. At first, he switched from an OTE to a BTE processor with a magnet strength of 6. However, he continued to report retention issues. On examination, a thick scalp made palpation of the implant body difficult. Two 0.9cc of triamcinolone over a 4-week interval were injected with resolution of patient’s retention problems.

Patient 4

A 67-year-old patient had been implanted with a right CI24RE in 2009 and a left one in 2021. Six months after his left surgery, he had issues with left magnet retention even with the strongest magnet available (strength 5). He received a 0.3cc TI. The patient’s condition improved and he has been wearing his left BTE processor for 13.5hrs/day.

Patient 5

A 20-year-old patient underwent bilateral HiRes Ultra CI in 2016. His BMI at the time was 31.95. One year after surgery, he started having difficulties with magnet retention on the right side when he started gaining weight. He had shaved his head, but no improvement. On examination, there was a keloid scar around the right implant site. Although he received 4 TI (0.5cc for the first two injections, followed by two injections of 0.8cc), he continued to experience retention problems. Finally, he underwent a SFR procedure over the implant and received TI intraoperatively. The patient refused further TI postoperatively. The magnet was still falling off and he stopped wearing his right processor.

Patient 6

A 37-year-old patient who received her right and left CI622 in 2021 and 2022, had been wearing her right and left OTE processors with a magnet strength of 5 for 11.1hrs/day and

6.2hrs/day, respectively. She reported that her CI were not staying on her head properly and fell off with minimal movements, even after cutting her hair. She received a bilateral 0.5cc TI that helped reduce the thickness of the scalp around the implant. On follow-up, the patient reported wearing her OTE processors for 11.9hrs/day and did not require another injection.

Patient 7

A 70-year-old man obtained his left CI622 in 2019. Two months after his surgery, he reported magnet retention issues despite increasing the magnet strength. He started using a hat to keep it on for 3.6hrs/day. At the time his BMI was 37.7. On physical examination, the skin was thick around the implant. He received a total of 7 TI with the first two being 0.3cc, followed by two injections of 0.4cc, then two injections of 0.8cc, and finally one injection of 1cc. After the injections, he was able to retain his left processor for 6hrs/day.

Discussion

The external audio processor and the implant under the skin contain magnets to ensure the fixation of the sound processor. Insufficient magnetic force can result in a loss of the connection between the sending and receiving coils or difficulties retaining the device. In addition, a thick scalp increases the distance between these magnets which can also create retention issues. Most CI manufacturers advise a skin thickness no greater than 7mm to allow proper magnet retention.[4] However, surgeons are reluctant to carry out a SFR surgery in patient with thick skin scalp due to increased risk of infection, skin necrosis, abscess formation, and CI extrusion.[5,7] Several studies have found a positive correlation between skin thickness and magnet strength, and skin thickness and BMI.[4,6,8,9,10] Nevertheless, patients with normal BMI (patients 4&6) might also have scalp thickness >7mm, putting them at risk of magnet retention issues. In our study, the temporoparietal scalp thickness, measured on preoperative CT scans, varied between 8.3mm and 15.9mm, which suggested a potential risk factor for the occurrence of retention issues.

Corticosteroid injections are a potential method to reduce the inflammatory response and fibroblast proliferation after surgery which may translate into better CI retention.[11] In obese patients, triamcinolone causes atrophy of the subcutaneous fat layer and thins the overall skin.[6] Note that intradermal injection should not be performed as it causes dermal thinning and ulceration. The effects of the injections are delayed and usually take 4 to 6 weeks. Therefore, they should be given at intervals of no shorter than 4 weeks. Potential complications of TI include subcutaneous atrophy, hypopigmentation, telangiectasia, and delayed wound healing, which all occur from intradermal injection.[12] In addition, if accidentally injected in the cochlea, Huang et al. demonstrated that it may delay the rise in impedance, but ultimately it will not prevent it.[13] In case TI do not help resolve retention issues (e.g., patient 5), SFR surgery can be performed but will generally require post-operative injections to prevent re-formation of scar.

Because TI is a relatively non-invasive procedure that can be done in an office setting, it can be offered to individuals whose retention issues are due to postoperative edema, hypertrophic scar, and fat hypertrophy from obesity. This study is limited by small sample

size. Additionally, post-injection CT scans to evaluate skin thickness were not obtained. Future case series should examine larger cohorts of patients to allow the implementation of new guidelines.

Conclusion

Six of the seven selected patients (7 out of 8 implant sites) have shown full resolution of their issues with an average of 2.6 injections (0.3 to 1.0cc). Therefore, consideration should be given to steroids injection before proceeding to flap thinning procedures.

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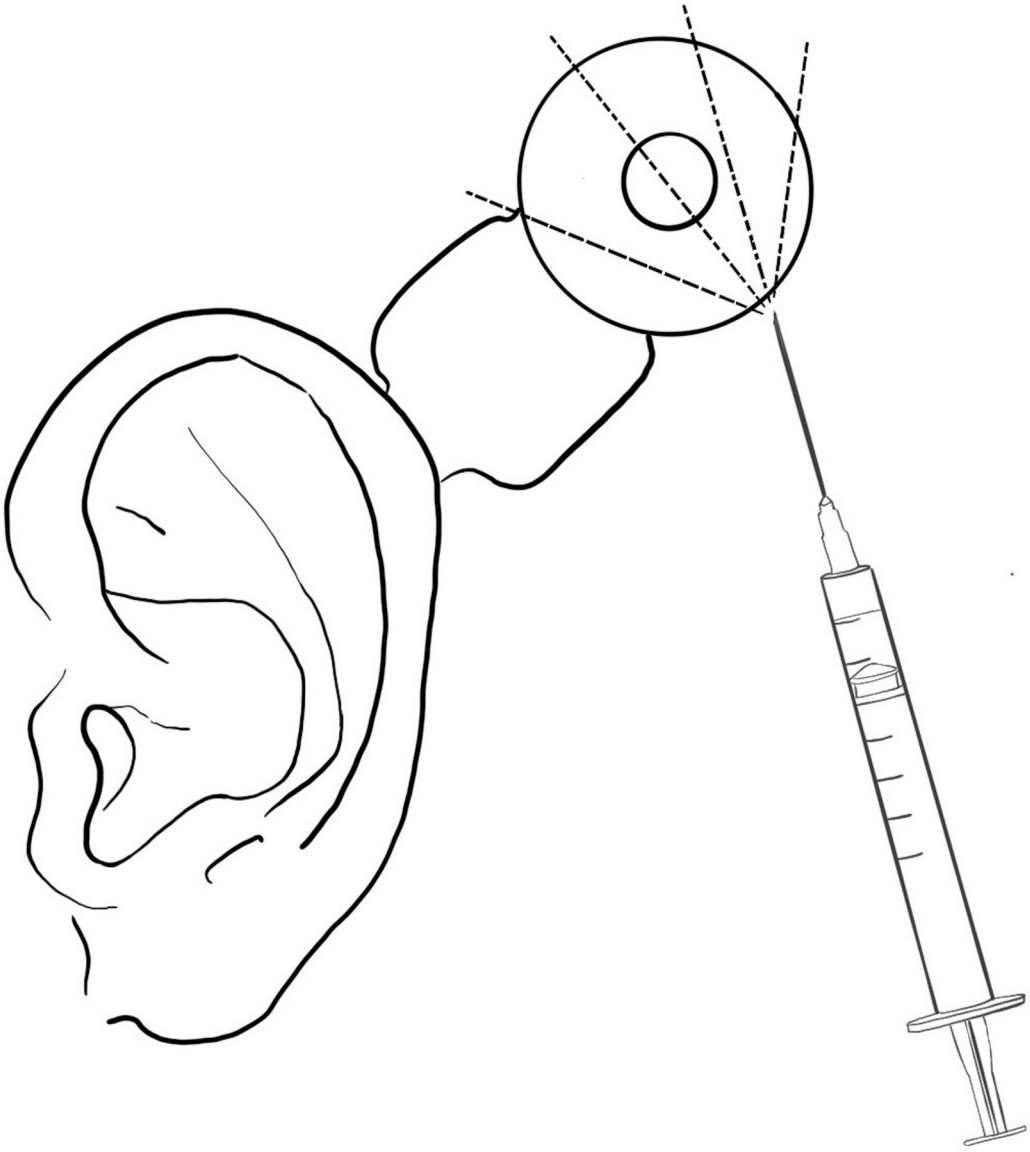

Figure 1.

An illustration of the subcutaneous injection technique of triamcinolone for cochlear implant magnet retention problems. It involves injecting the medication through the same entry point in three different directions at subdermal depth, thus distributing triamcinolone evenly and minimizing the risk of infection.

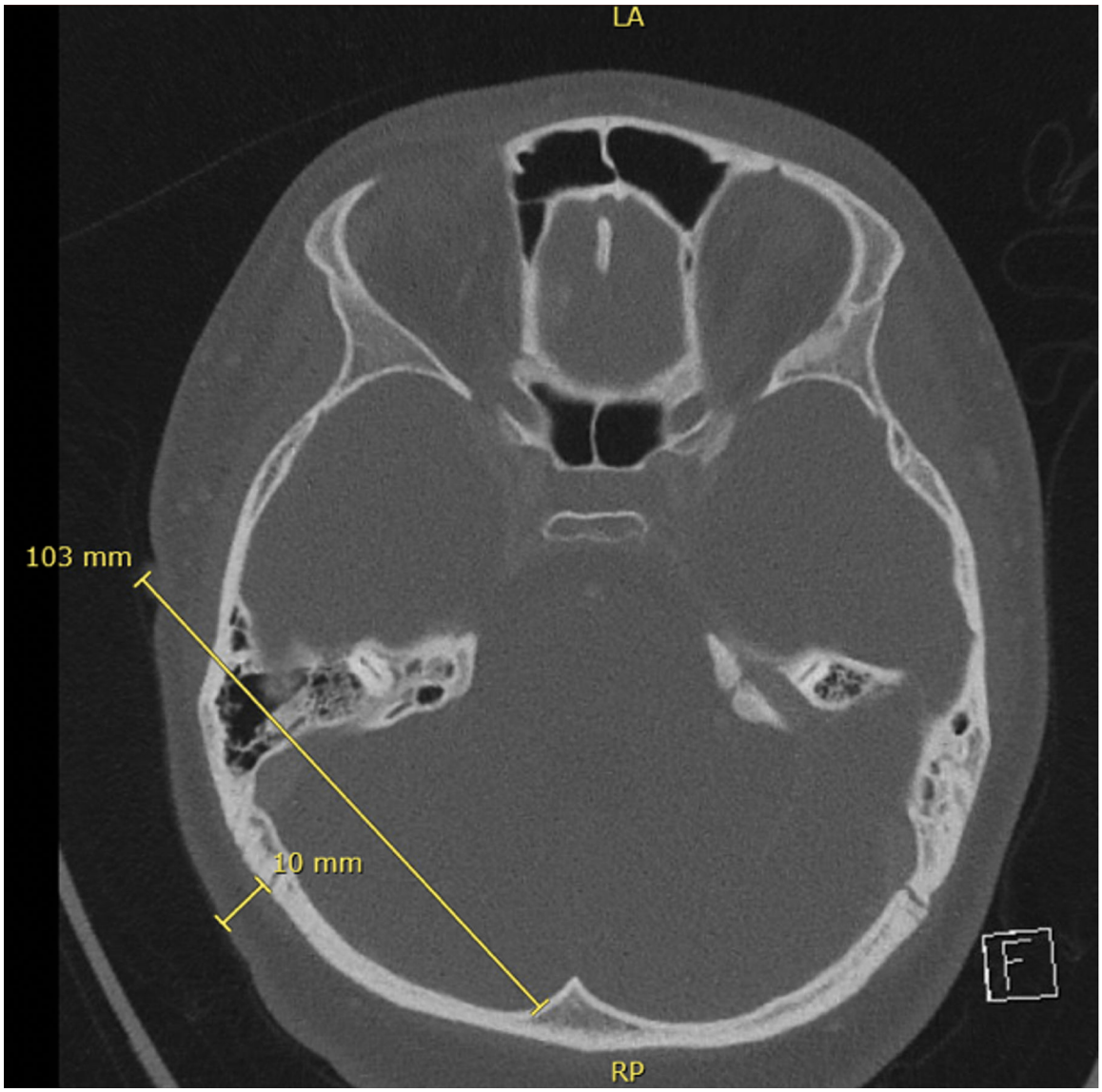

Figure 2.

Method of skin thickness measurement. To determine the temporoparietal scalp thickness, a line was drawn from the top of the pinna on the CI receiver side to the internal occipital protuberance in the axial plane. At the center of the line, the perpendicular line going from the outer cortex to the most superficial aspect of the scalp was considered the skin thickness.

Table 1.

Summary and Demographic Information of the Patients' Cohort

Patient	Gender	Age	Implant Side	CI use (years)	Type of Implant – Maximum Magnet Strength	Type of Sound Processor	Final Magnet Strength	BMI (Kg/m^2)	Pre-operative Skin Thickness	No. of Triamcinolone Injections	Triamcinolone Dosage	Follow-up
1	M	25	Left	22	Nucleus CI24M by Cochlear - 6	BTE	6	34.1	-	Left: 1	Visit 1: 0.3cc	Wearing processor
2	M	76	Bilateral	Right: 3 Left : 7	Synchrony MI1200 by MED-EL - 5	BTE	4	29.23	Right: 8.4 mm	Right: 1	Visit 1: 0.3cc	Wearing processor for 14hrs/day
3	M	29	Left	26	Nucleus CI24M by Cochlear - 6	Switched from OTE to BTE	6	59.96	-	Left: 2	Visit 1 & 2: 0.9cc	Wearing processor
4	M	67	Bilateral	Right: 13 Left 2	Nucleus Freedom CI24RE by Cochlear - 6	BTE	4	24.8	Left: 9.4 mm	Left: 1	Visit 1: 0.3cc	Wearing processor for 13.5hrs/day
5	M	20	Bilateral	Right: 22 Left: 5	CI-1600–04 HiRes Ultra by Advanced Bionics - 6	BTE	5	34.2	Right: 10.0 mm	Right: 4	Visit 1 & 2: 0.5cc Visit 3 & 4: 0.8cc	Unable to wear processor and refusing post-op injections
6	F	37	Bilateral	Right: 2 Left: 1	Nucleus Profile Plus CI622 by Cochlear - 6	OTE	5	18	Right: 8.7 mm Left: 10.3 mm	Right: 1 Left: 1	Visit 1: 0.5cc	Wearing processor 11.9hrs/day on both sides
7	M	70	Bilateral	Right: 16 Left: 3	Nucleus Profile Plus CI622 by Cochlear - 6	BTE	5	37.7	Left: 15.9 mm	Left: 7	Visit 1 & 2: 0.3cc Visit 2 & 3: 0.4cc Visit 4 & 5: 0.8cc Visit 6: 1cc	Wearing processor for 6hrs/day

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