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TESTING THE FEASIBILITY OF RESTORING THE HIGH-FREQUENCY DYNAMIC VISUAL ACUITY WITH A VESTIBULAR IMPLANT PROTOTYPE IN HUMANS

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Keywords: vestibular prosthesis, vestibular implant, neural prosthesis, bilateral vestibulopathy, functional head impulse test, dynamic visual acuity.

Relevance

During abrupt head rotations, the semicircular canals in the vestibular system detect acceleration and induce an ocular reflex that generates compensatory eye movements: the vestibulo-ocular reflex (VOR). This mechanism allows the visual environment to remain stable on the retina to preserve visual acuity in dynamic conditions (DVA). Unfortunately, the VOR is often impaired in case of bilaterally reduced (or absence of) vestibular function, a condition called “bilateral vestibulopathy”. This results in loss of DVA, and, therefore, patients frequently complain of oscillopsia: the illusory movement of the visual environment.

A new test involving fast and high-frequency head movements was recently proposed to assess DVA: the functional Head Impulse Test (fHIT) (1). In this test, patients undergo abrupt head impulses to the right and left and have to identify optotype letters (Landolt C rings) that appear briefly during these impulses. The percentage of correctly identified optotypes is calculated for head impulses to each side.

At this moment, no definite therapeutic option is yet clinically available for bilateral vestibulopathy. However in the last years the feasibility of a possible treatment has been demonstrated: the vestibular implant (VI) (2). The VI attempts to restore head-motion sensitivity by capturing motion and delivering it as electrical current pulses to vestibular afferents via surgically implanted electrodes.

Objective

The goal of this case study was to investigate the feasibility of restoring the high-frequency DVA with a prototype vestibular implant, using the fHIT.

Material and methods

A 72-years old female with bilateral vestibulopathy and fitted with a modified cochlear implant incorporating three vestibular electrodes (MED-EL, Innsbruck, Austria), was available for this study. Electrical stimulation was delivered with the electrode close to the lateral ampullary nerve in the left ear. The high-frequency DVA in the horizontal plane was tested with the fHIT. After training, the patient underwent six trials of the fHIT, each with a different setting of the vestibular implant: 1) System OFF before stimulation; 2) System ON, baseline stimulation; 3) System ON, reversed stimulation; 4) System ON, positive stimulation; 5) System OFF, without delay after stimulation offset 4; 6) System OFF, 25 minutes delay after stimulation offset. The fHIT scores for right and left head impulses were compared between trials using Logistic regression.

Results

Vestibular implant stimulation improved the high-frequency DVA compared to no stimulation (see Table). This improvement was significant for “System ON, baseline stimulation” ($p = 0.02$) and “System ON, positive stimulation” ($p < 0.001$). fHIT scores changed from 19–44% (no stimulation) to maximum 75–94% (System ON, positive stimulation).

Percentage and absolute number of correctly determined Landolt C-optotypes in left- and rightward directed impulses during different test conditions. * = Significant improvement compared to condition System_{off}

Side Condition	Left (Implanted) % Correct answers, (absolute number)	Right % Correct answers, (absolute number)
System _{off}	19 (3/16)	19 (3/16)
System _{on} ^{baseline*}	50 (8/16)	56 (9/16)
System _{on} ^{reversed}	38 (6/16)	25 (4/16)
System _{on} ^{motion*}	94 (15/16)	75 (12/16)
System _{off} ^{0min}	44 (7/16)	38 (6/16)
System _{off} ^{25min}	38 (6/16)	19 (3/16)

Conclusion

The vestibular implant seems capable of improving the high-frequency DVA. This functional benefit of the vestibular implant illustrates again the feasibility of this device for clinical use in the near future.

Acknowledgements

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OUTCOMES OF PAEDIATRIC DENTAL REHABILITATION FOLLOWING HEAD AND NECK RECONSTRUCTION: A SYSTEMATIC REVIEW

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Introduction

Dental rehabilitation is an important part of a patient's treatment following head and neck reconstruction and can provide significant improvements in both functional and psychosocial outcomes. The current literature is particularly scarce with regards to dental rehabilitation in children. The aim of this work is therefore to examine the best techniques available for paediatric dental rehabilitation, including the ideal sequence of events to support the best outcomes.

Material and methods

A literature search was performed of all children undergoing dental rehabilitation following head and neck reconstruction between 1975 and June 2019 using the MEDLINE and Cochrane databases. Each article was assessed for inclusion before data was extracted. Data items extracted for each article included: age; primary pathology; surgery; dental rehabilitation details; radiotherapy; functional outcomes; and psychological outcomes.

Results

Six articles were finally in the final analysis, all of which were case reports or case series. The patient's primary pathologies were a mixture of congenital deformities, benign tumours, malignancies and infections. All of the reconstructive options, including free scapular, parascapular, iliac crest and fibula flaps were reported to be successful. Positive outcomes were demonstrated following both im-

mediate and delayed dental rehabilitation with removable and osseointegrated prostheses.

Radiotherapy was not performed in any of the cases.

Conclusions

From the cases examined, it has been demonstrated that a variety of osseous free flap reconstructive options can facilitate successful dental rehabilitation in children. However, the outcomes reported for each of the studies varied greatly, with no two studies reporting their outcomes in the same way. Additionally, although this small selection of studies shows some positive results for dental rehabilitation following paediatric head and neck reconstruction, no firm conclusions can be made, particularly regarding long-term outcomes. Many more cases must therefore be reported and examined in order to make any wider-reaching conclusions for paediatric patients.

THE BEST TECHNIQUE FOR MICROSURGICAL EAR REPLANTATION IN CHILDREN: A SYSTEMATIC REVIEW

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Background

Whilst there have been studies reviewing the various techniques available for auricle reattachment, no systematic review has specifically focused on the paediatric population. The aim of this systematic review was to examine the best microsurgical technique for successful ear replantation in children.

Material and methods

A literature search of all children undergoing microsurgical ear replantation was performed between 1980 and 1st June 2018 using the MEDLINE and Cochrane databases.

Results

A total of three articles were included in the final analysis, all of which were case reports. Two reported on artery-only and one reported a combined artery and venous replantation.

All replantations survived until the end of the follow up period (range 8 months – 4 years). Arterial thromboses occurred in one artery-only and one artery and venous anastomosis. However, the artery-only anastomoses resulted in more complications overall, including areas of partial necrosis requiring debridement and reconstruction, and the need for blood transfusion with the use of medicinal leeches.

Conclusions

From the cases examined, techniques involving both arterial and venous anastomoses seem the