Single versus dual innervation in facial palsy reanimation with free functional muscle transfer: a Systematic Review and Meta-Analysis

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Objectives

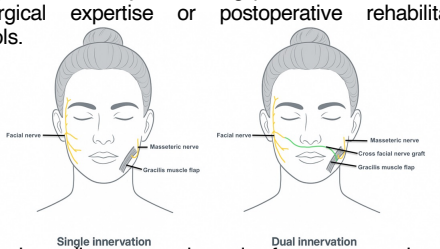
In chase of long-standing facial palsy, free functional muscle transfers (FFMTs) have emerged as the gold standard for reanimation. However, the ongoing debate about the various options for neuronal input to power the transferred muscle remains, especially whether a single or two different nerves should be used. The purpose of this study was to review the available clinical data on single versus dual innervation in FFMTs and compare their outcomes to better understand if dual innervation offers a significant benefit.

Methods

A systematic review and a meta-analysis were conducted according to the PRISMA 2020 guidelines. Cochrane Library, EMBASE and MEDLINE (via PubMed) were systematically searched on the 13th of March 2024. Studies not written in English, other reviews, case reports, animal studies, and cadaveric studies were excluded. Given the heterogeneity of studies, surgical techniques and outcome-measurements used, studies were further selected for inclusion in quantitative evaluation and meta-analysis.

Results

From the identified 451 studies, 16 were included. Among these, four were comparative studies and 12 single cohort studies. All but one had a retrospective design and 5 were multi-center studies. A total of 256 patients were included in these 16 studies, 71 in the single-innervation group (15 CFNG, 56 masseter) and 175 in the dual-innervation group (146 CFNG + masseter, 29 CFNG + hypoglossal).
To improve comparability, only studies that provided original outcome data on both single as well as dual innervation patients were considered for quantitative analysis. This left us with cohorts in which the same surgeons performed both techniques, effectively minimising potential differences due to surgical expertise or postoperative rehabilitation protocols.



Four such studies reported results from masseteric nerve alone as well as masseteric nerve combined with a CFNG from the contralateral facial nerve.
Table 1 shows the mean improvement percentage in post-treatment scores for the single and dual innervation groups individually. Both showed a statistically significant mean improvement (41.09% for single and 50.74% for dual innervation).
Figure 1 compares the reported perioperative improvements for both treatment options of the included studies as well as for the pooled single versus dual innervation groups. For patients in the single innervation group results were overall more consistent across the groups, whereas the patients in the dual innervation group demonstrated a higher mean improvement, albeit with greater variability and no statistically significant difference.

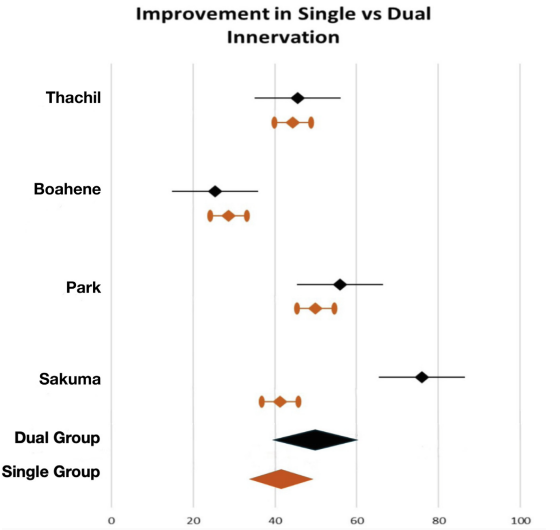


Figure 1: Visualization of the reported postoperative improvement of included studies in percentage. Single innervation results are displayed in brown, dual innervation in black.

Discussion

The goal of facial reanimation with FFMT is to restore static and dynamic facial symmetry and to allow patients to regain a spontaneous smile, optimally with the lowest burden in scars, donor site morbidity and surgical time needed. Both techniques mentioned show remarkable outcomes but are afflicted with specific limitations and drawbacks.
Our meta-analysis was unable to demonstrate any statistically significant differences in overall outcome between single and dual innervation FFMT. While the mean improvement in dual innervation patients was slightly higher, this group also displayed a higher variability in outcome. The choice between dual- and single-innervation methods is currently mostly influenced by patient factors and surgeon's preference. The use of different grading systems for assessing post-operative outcome hampers the comparison of results. Additionally, due to small sample sizes in several studies, heterogeneity within patient populations and different follow-up durations, limitations occur even when comparing results assessed using the same grading system.

Conclusion

The dual innervation patients tended to have longer palsy durations and slightly better but more varied post-treatment improvements with however no statistically significant difference to the single innervation group. Choosing the best option for the patient may depend on different factors such as the age of the patient, the underlying cause of the palsy and specific surgical factors. The existing literature as shown in this study is inconsistent and definitive deductions are hindered by varying outcome measures.

Table 1: One-sample t-test for analysis of mean overall improvement percentages in outcome measurement scores for both groups.

One-sample test

	Test value = 0					
					95% confidence interval of the difference	
	t	df	Sig. (2-tailed)	Mean difference	Lower	Upper
Improvement post vs pre (%) - single innervation	9.115	3	.003	41.09	26.74	55.44
Improvement post vs pre (%) - dual innervation	4.811	3	.017	50.74	17.18	84.31