Transverse Changes Following Surgically Assisted Rapid Palatal Expansion – A Systematic Review

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INTRODUCTION

Surgically Assisted Rapid Palatal Expansion (SARPE) was developed to allow for transverse expansion of the maxillary bone in skeletally mature patients by surgically releasing bony resistance before expansion.

The surgical procedure typically consists of a Le Fort I osteotomy and corticotomy along the mid-palatal suture. The expander was activated afterwards to facilitate maxillary expansion.

However, complications such as uneven expansion and unstable occlusion have also been reported to be up to 13.3%.[1] Currently, there is no systematic review that compares the changes of bilateral landmarks after SARPE.

Therefore, the objective of this systematic review is to analyze the positional changes of various bilateral landmarks on the maxillary and dentoalveolar complex in the transverse dimension after SARPE to serve as a guide for future orthodontists and surgeons.

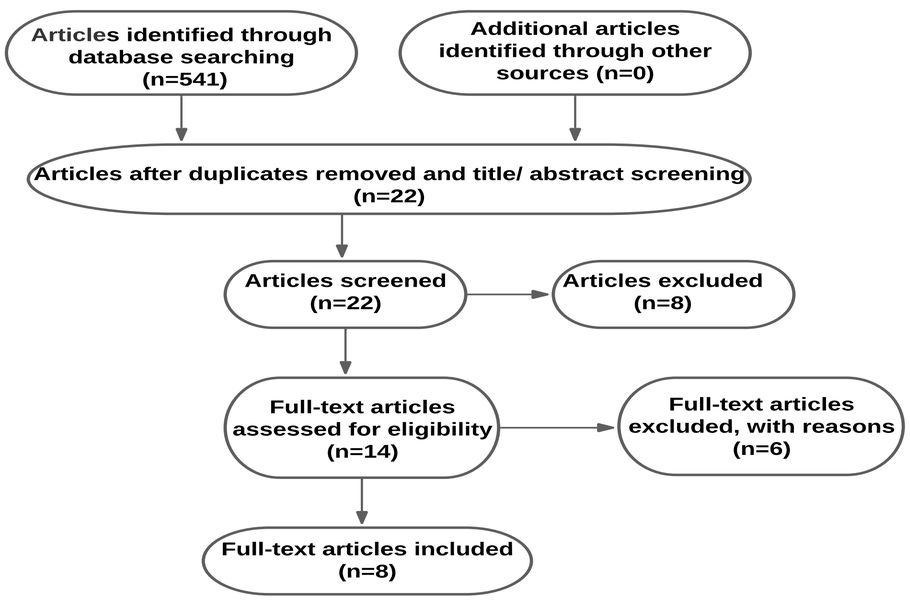
METHODS & MATERIAL

This systematic review followed the PRSIMA guideline and original articles published up to January 2021 were searched.

The inclusion criteria were as follows: (a) original human studies with maxillary transverse deficiency; (b) patients treated with SARPE; (c) studies measuring change of dentoalveolar or skeletal landmarks on the right and left side of the skull; and (d) studies using CBCT. Exclusion criteria were as follows: (a) Three-piece SARPE; (b) patients presenting with craniofacial anomalies such as cleft palate etc.; (c) measurements done on posteroanterior cephalogram, cast models or any records other than CBCT; (d) any other surgical procedure performed on the maxilla in addition to SARPE; (e) in vitro or animal studies; and (f) articles that were not written in English.

The following search strategy was applied : (Surgically assisted rapid maxillary expansion OR Surgically assisted rapid palatal expansion OR Transpalatal distraction osteogenesis) AND (Asymmetry OR Transverse OR complications).

The Newcastle-Ottawa Quality Assessment Scale (NOQAS) for case-control studies was applied to evaluate the methodological quality of the selected articles.



ARTICLES INCLUDED

Author	Number of Patients	Mean age at T1	Method	PMF release	Device	Activation Period	Retention
Nada et al (2012)[2]	45 (17M, 28F)	Hyrax – 24.5 Bone-borne expander – 29.4	Case Series	Yes	Hyrax (17) Bone-borne expander (28)	1 mm per day 1 week after surgery until the palatal cusps of upper teeth touch the buccal cusps of lower teeth	Expander left in place for 3 months before being replaced by transpalatal arch.
Zemann et al(2011)[3]	18 (10 M, 8 F)	26	Case Series	Yes	Haas	Activated 1 mm during surgery, then 2 turns per day starting from second day after surgery until overexpansion	Expander left in place for 6 months.
Tausche et al (2007)[4]	10 (4M, 6F)	25.3	Case Series	No	Bone-borne expander	4 turns per day for 8±2 days to reach an average screw expansion of 7.25 mm	Expander left in place for 3-6 months before being replaced by transpalatal arch
Magnusson et al (2012)[5]	35 (14M, 21F)	19.7	Case Series	No	Hyrax	2 turns per day 5 days after surgery until overexpansion up to half a cusp (mean expansion period – 15 days)	Expander left in place for 90 days before being replaced by transpalatal arch
Huizinga et al (2018)[6]	20 (12M, 8F)	24.5	Case Series	No	Bone-borne expander	1 or 2 turns per day 5-7 days after surgery until adequate expansion	Expander left in place for 3 months
Hansen et al (2007)[7]	12	25.3	Case Series	No	Bone-borne expander	4 turns per day 3 days after surgery until the amount desired (average screw expansion of 6 mm)	Did not specify
Ferraro-Bezerra et al(2018)[8]	24 (6M, 18F)	With PMF release - 27 Without PMF release - 27.5	RCT	Yes - 12 (3M, 9F) No – 12 (3M, 9F)	Hyrax	Activated 1 mm during surgery, then 2 turns per day 6 days after surgery until crossbite was no longer observed	Expander left in place for 6 months
Seeberg et al (2015)[9]	33 (14M, 19F)	Hyrax – 22 Bone-borne expander - 30	Case Series	No	Hyrax (14) Bone-borne expander (19)	Activated 0.8 mm during surgery, then 2 turns per day 5-7 days after surgery	Expander left in place for 3 months

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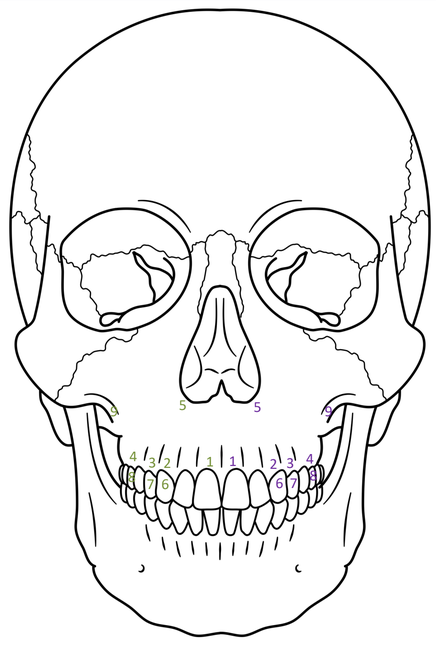
RESULTS



1,1 Upper Right and Left Ectoincisor
2,2 Upper Right and Left Ectocanine
3,3 Upper Right and Left Ectopremolare
4,4 Upper Right and Left Ectomolare
5,5 Right and Left Alare
6,6 Upper Right and Left Canine
7,7 Upper Right and Left 1st Premolar
8,8 Upper Right and Left 1st Molar
9,9 Right and Left Processus Zygomaticus

Author	Results	
Nada et al. (2012)[2]	Hyrax Expansion on the right segment – 1.84±1 mm Bone-borne expander Expansion on the right segment – 1.91±0.97 mm	Expansion on the left segment – 1.56±1.11 mm Expansion on the left segment – 1.69±0.78 mm
Zemann et al (2011)[3]	**Tipping of UR3 – 1.9±1.0°** **Tipping of UR6 – 2.8±1.3°**	**Tipping of UL3 – 1.9±1.0°** **Tipping of UL6 – 2.9±1.4°**
Tausche et al (2007)[4]	Tipping of UR4 – 3° Tipping of UR6 – 3.5° Tipping of UR ectopremolare - 11.1° Tipping of UR endopremolare – 13.3° Tipping of UR ectomolare – 10.6° Tipping of UR endomolare – 11.8°	Tipping of UL4 – 3.9° Tipping of UL6 – 2.5° Tipping of UL ectopremolare – 10.8° Tipping of UL endopremolare – 9.9° Tipping of UL ectomolare – 11.8° Tipping of UL endomolare – 10.2°
Magnusson et al (2012)[5]	**Expansion of right alare – 1.29 mm** **Expansion of UR ectocanine – 1.71 mm** **Expansion of UR processus zygomaticus-1.57mm** **Expansion of UR ectomolare – 2.37mm**	**Expansion of left alare – 1.23 mm** **Expansion of UL ectocanine – 1.73 mm** **Expansion of UL processus zygomaticus –1.23 mm** **Expansion of UL ectomolare – 2.04 mm**
Huizinga et al (2018)[6]	Difference in (left side subtracted from right side) Expansion of inferior-anterior (ectoincisor) – 0.36 mm Expansion of inferior-posterior (ectomolare) – - 0.03 mm Expansion of superior-posterior (processus zygomaticus) – 0.10 mm	
Hansen et al. (2007)[7]	Tipping of UR4 – 4.62±3.72° Tipping of UR6 – 2.58±4.07° Tipping of UR ectopremolare – 8.62±5.17° Tipping of UR endopremolare – 8.22±4.85° Tipping of UR ectomolare – 8.01±3.04° Tipping of UR endomolare – 8.05±3.52°	Tipping of UL4 – 3.09±4.44° Tipping of UL6 – 1.13±6.02° Tipping of UL ectopremolare – 9.66±9.18° Tipping of UL endopremolare – 7.99±6.37° Tipping of UL ectomolare – 9.75±6.41° Tipping of UL endomolare – 8.74±8.54°
Ferraro-Bezerra et al. (2018)[8]	With PMF release – Tipping of UR3 – 4.2° Tipping of UR6 – 4.3° Without PMF release – Tipping of UR3 – 3.6° Tipping of UR6 – 6.2°	 Tipping of UL3 – 3.6° Tipping of UL6 – 4.9° Tipping of UL3 – 3.0° Tipping of UL6 – 7.2°
Seeberg et al. (2015)[9]	Hyrax expander Tipping of UR4 – 3.59° Tipping of UR6 – 5.16° Bone-borne expander Tipping of UR4 – 1.49° Tipping of UR6 – 3.44°	 Tipping of UL4 – 2.09° Tipping of UL6 – 4.87° Tipping of UL4 – 2.61° Tipping of UL6 – 1.13°

CONCLUSION

The inclusion or absence of PMF release during surgery, as well as the design of the expander, were found to be two major differences in methodological approach.

There's no statistically significant difference between patients going through PMF release and those who did not. However, greater posterior expansion, less molar tipping, and more parallel opening along the mid-palatal suture can be seen in PMF release cases.

In terms of expander design, two studies compared bone-borne and tooth-borne expanders[2,9], with only one indicating a significant difference in the angulation of the left molar after SARPE[9]. There were no significant difference in skeletal expansion or first premolar angulation changes between expander designs.

Overall, SARPE patients develop expansion and tipping in the maxillary basal bone, dentoalveolar complex and maxillary dentition. The incorporation of PMF release during surgery or expander design do not affect the result of SARPE expansion clinically. Clinically relevant asymmetry of up to 3 mm is a common complication (reported in one of the studies to be up to 55%)[6] and should be further explored.

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