Headache and Transverse Maxillary Discrepancy

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The purpose of this study is to evaluate the usefulness of rapid palatal expansion in growing patients to eliminate the nasal pyramid stenosis as a cause of primary headache. Patients were invited to participate in the clinical study at the University of Milan, Department of Orthodontics. Forty-one growing patients of both genders suffering from primary neurovascular headaches and having transverse maxillary deficiency were studied before and after rapid palatal expansion. A clinical examination, postero-anterior radiography and rhinomanometry were performed. After rapid palatal expansion (RPE) therapy all patients showed a constant and important increase in the values relating to both skeletal and dental structures, a significant reduction in the mean nasal resistance, and a significant decrease or elimination of headache symptoms. This therapy provides a preventive alternative for surgical procedures, such as the neurovascular decompressive septo-ethmoidosphenoidectomy performed in adult patients.

Keywords: *Primary headache, rapid palatal expansion, rhinomanometry, postero-anterior radiography, rhinogenous trigger.*
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INTRODUCTION

Although neurovascular primary headaches are usually associated with neurology and otorhinolaringology, they should not be exclusive of medical specialties.

The incidence of neurovascular primary headaches is unknown. The etiology appears to be a reduced volume of the ethmoidosphenoidal subcribriform chamber according to the haemoangiokinetics of this area.

Bonaccorsi[1,2] and Novak[3,4] independently identified the pathophysiologic mechanism and trigger zone (dysmorphism) for various types of neurovascular primary headaches.

Bonaccorsi[2] has been studying the ethmoido-sphenoidal archistructural alterations and the problems of neurovascular headaches since 1971,[3,4] and demonstrated how neurovascular decompressive functional morpho-corrective rhino-skull base surgery on 2,124 cases leads to important clinical improvements of headache.[2]

Novak[5] reported that 446 patients with various types of headaches (migraine, cluster headache, idiopathic primary headaches) had surgical treatment such as septal correction, resection of the middle and superior concha, ethmoidectomy, sphenoidectomy on the corresponding headache side or occasionally on both sides. Most patients (90%) were asymptomatic after surgery and 10% continued to experience occasional headache.

In 1999 Ramadan[6] proposed endoscopic sinonasal surgery as a helpful method to alleviate primary headache.

The aim of this study is to demonstrate that correction of transverse maxillary deficiency in growing patients not only can improve the nasal respiratory function, but also the haemoangiokinetics of this area, reducing headache symptoms.

MATERIALS AND METHODS

Two hundred and fifty growing patients having monolateral or bilateral molar cross bite were invited to participate in the clinical study at the University of Milan, Department of Orthodontics. Forty-one (21 females and 20 males), aged 6-12 years, suffering from primary neurovascular headaches and having transverse maxillary discrepancy, were studied before and after rapid palatal expansion. The study was conducted clinically, through postero-anterior radiographs and with the help of rhinomanometry. (Figs. 1-2)

The diagnosis of maxillary constriction was based on the

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Table 1. Postero-anterior radiograph Mean of cephalometric measurements at the end of Rapid Palatal Expansion Therapy and at the end of the maintenance period

	age	mxs-d before	mxs-d end	mxs end of maintenance	CVM before	CVM+s-d end	end of maintenance CVM+sd	X-SNM before	X-SNM end	X-SNM end of maintenance	SNM-SNAC before	SNM-SNAC end	SNM-SNAC end of maintenance	piriform aperture before	piriform aperture end	piriform aperture end of maintenance	SNI-MID before	SNI-MID end	SNI-MID end of maintenance
mean	9,025	61,125	64,9375	65,28125	55,5	61,75	62,8125	26,9375	26,875	27,8125	20,9375	22,71875	23,25	30	32,34375	32,9375	0,65625	0,28125	0,125
median	9,15	62	66	66	56	62	63,5	27,5	28	29	22	23,5	23,5	29	30	31	0,5	0	0
ds	1,322371607	3,48090027	3,33604057	3,72365748	4,305035811	4,75394573	5,08879488	4,10639745	4,5	4,49026725	2,86283659	3,04394892	2,76887462	9,32380466	10,3065008	9,97643056	0,65112083	0,36371921	0,28867513
min	6,9	53	57	57	43	49	50	20	19	20	16	16,5	17	20	22	23	0	0	0
max	11	65	69	70	62	69	70	32	34	35	24	27	27	62	68	68	2	1	1

presence of at least one of these two characteristics:

1) The line PAS (orbit-sphenoidal point)-MX that is inside CVM- point
2) The different distance and the different heights of the two cephalometric Mx points and the symmetry axis.

Different types of headache were diagnosed on the basis of the "headache classification committee of the International Headache Society": migraine with or without aura (20 cases), cluster headache (5 cases), chronic paroxysmal hemicrania (6 cases), tension-type headache (10 cases). The diagnosis was based on clinical, radiographic and NMR evidence. Other possible causes of craniofacial pain were excluded: post-meningitis headache, new daily persistent headache with medication rebound, neoplasma, temporal arteritis, chronic meningitis, chronic subdural hematoma, post-traumatic headache, sphenoid sinusitis, hypertension, subaracnoid hemorrhage, low cerebrospinal fluid pressure syndrome, cervical artery dissection, pseudotumor cerebri, cerebral venous thrombosis.

Patients were asked to record the number of headache episodes experienced every week during the six months preceding therapy. The 41 patients had at least one episode of migraine per week. The pharmacological therapy (analgesics, ergot, tricyclic antidepressant) prescribed during these six months had no effect in the reduction of headache episodes.

The forty-one patients presented monolateral or bilateral cross-bite malocclusion.

Diagnostic postero-anterior radiographs (Figs. 1-2) showed deviation of nasal septum, transverse maxillary deficiency, and asymmetry of different cephalometric points (Mx, CVM +, CVM -).

The rhinomanometry revealed increased nasal resistance before therapy (mean of five observations). The computerized rhinomanometric examination was used with a vasoconstriction test to quantify the pattern of nasal resistance (Fig. 3).[8]

All patients received rapid palatal expansion therapy (Fig. 4), activating 0.5 mm a day for two weeks.

The clinical examination, posteroanterior radiography and rhinomanometry were repeated at the end of the expansion therapy and after six months of maintenance.

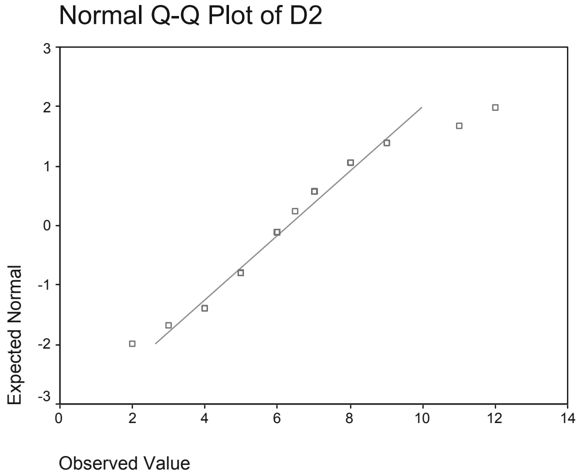
One hundred and seventy-nine growing patients of both genders with transverse maxillary deficiency and without neurovascular headache were recruited as the first control group.

The second control group consisted of 30 patients ages 6–12, suffering from primary neurovascular headache, and under pharmacological treatment only.

Table IIa. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
MXS_D1	41	52,00	65,00	60,6220	3,7629	14,160
MXS_D2	41	57,00	70,00	65,1707	3,5560	12,645
CVM1	41	43,00	63,00	55,2805	4,2867	18,376
CVM2	41	49,00	69,00	61,5854	4,4214	19,549
X_SNM1	41	17,00	33,00	26,7317	3,8602	14,901
X_SNM2	41	19,00	34,00	26,4756	3,9670	15,737
SNM1	41	16,00	28,00	21,7561	3,1047	9,639
SNM2	41	16,50	30,00	23,4024	3,2829	10,778
APERTUR1	41	20,00	63,00	28,7073	8,4120	70,762
APERTUR2	41	22,00	68,00	31,2073	8,9043	79,287
SNI1	41	,00	2,00	,4878	,5754	,331
SNI2	41	,00	1,00	,1707	,3084	9,512E-02
Valid N (listwise)	41					

Table IIb.



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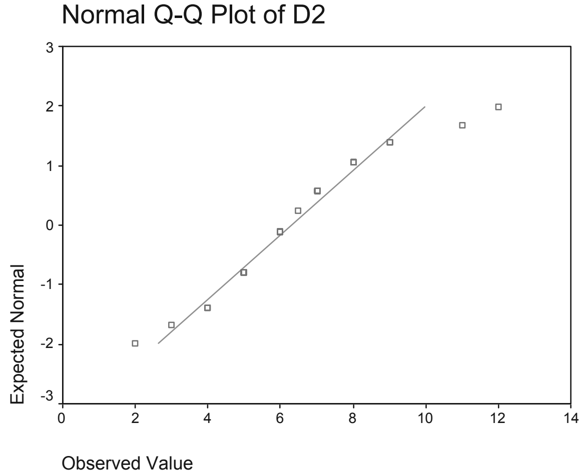

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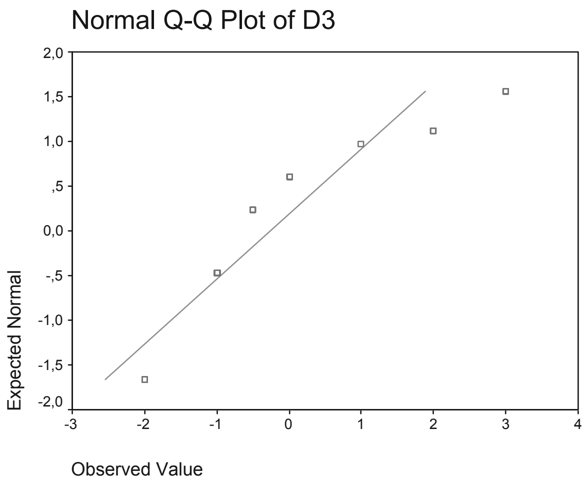

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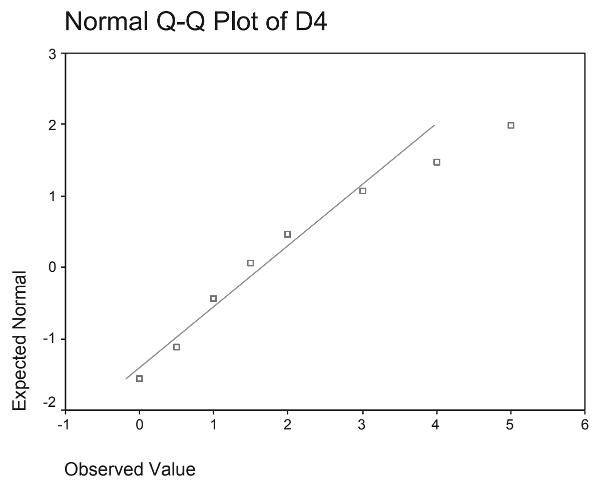

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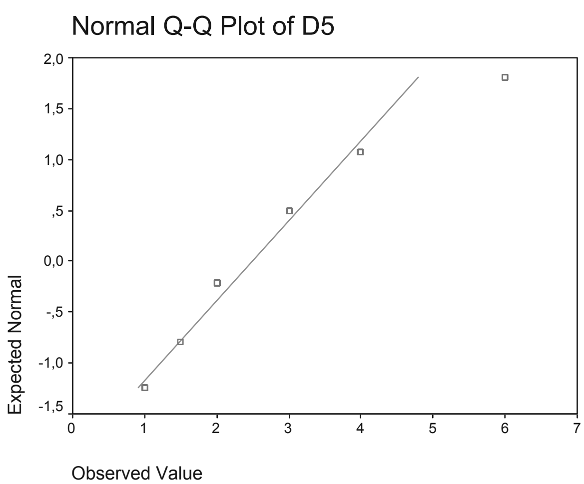

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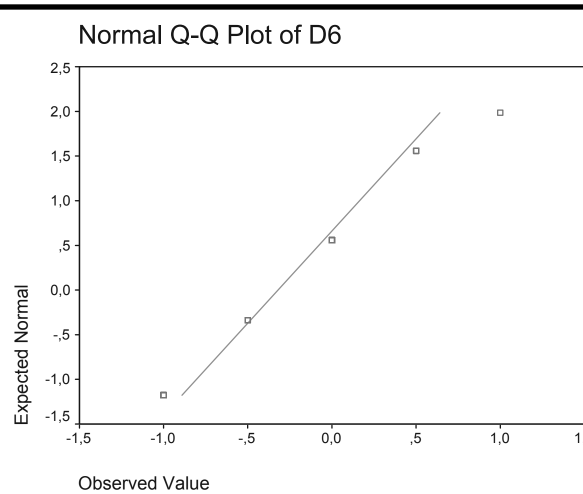

RESULTS

The distance between the two cephalometric Mx points showed a mean increase of 3.8 mm during activation and an increase of 0.34 mm in the 6 subsequent months.

The distance between the two CVM+ points showed a mean increase of 6.25 mm during activation and a subsequent increase of 1.06 mm during the following 6 months.

The length of the septum in its superior tract (X-SNM)

Table IIh. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
D1	,184	41	,001	,890	41	,010**
D2	,184	41	,001	,930	41	,022
D3	,267	41	,000	,759	41	,010**
D4	,222	41	,000	,882	41	,010**
D5	,262	41	,000	,859	41	,010**
D6	,232	41	,000	,869	41	,010**

**. This is an upper bound of the true significance.

a. Lilliefors Significance Correction

decreased by 0.06 mm during activation, but increased by 0.9 mm during the following 6 months. The inferior tract of the nasal septum (SNM-SNAC) increased by 2 mm during activation and by 0.5 mm in the following stage.

The mid septum distance from the axis of symmetry underwent a decrease of 0.4 mm during activation followed by an increase of 1 mm in the six-month maintenance period. The distance between the midpoint of the inferior tract of the nasal septum and the axis of symmetry increased by 2 mm during the period of activation and no evident variation was recorded during the following months. The width of the piriform aperture increased by 2 mm during the period of activation and by 1 mm more over the next 6 months.

The variables of interest were submitted to statistical analysis and were coded as six new variables as follows: d1(MXS 1- MXS 2), d2 (CVM 1 - CVM 2), d3 (X-SNM1 - X-SNM2), d4 (SNM-SNAC1- SNM-SNAC2), d5 (piriform aperture 1- piriform aperture 2), d6 (SNI1-SNI2), (TABLE II a-h).

For each variable the violation of the hypothesis of normal distribution for all data was verified by q-q plot and normality tests. Only for the variable d2 was the hypothesis of normality accepted. It was decided to proceed with standard t-test for these variable and non-parametric tests for all others.

By the analysis of the t test (TABLE III a,b), it is possible to underline that the use of the rapid palatal expander has a significant effect on the CVM variable.

The non parametric test (TABLE IV a-j) underlines the presence of a significant difference of the following variables before and after RPE therapy: maxillary width, length of the inferior tract of the nasal septum, and piriform aperture width. The analysis of these data underlines that the RPE has an influence on all the described variables.

Table III. the use of the rapid palatal expander has a significant effect on the CVM variable.

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
D2	41	6,3049	1,8604	,2905

Table III a

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
D2	21,700	40	,000	6,3049	5,7177	6,8921

Table III b

Table IV. a-d

Non parametric test

Variable MXS (d1)

Ranks

		N	Mean Rank	Sum of Ranks
MXS_D2 - MXS_D1	Negative Ranks	0[a]	,00	,00
	Positive Ranks	41[b]	21,00	861,00
	Ties	0[c]		
	Total	41		

a. MXS_D2 < MXS_D1
b. MXS_D2 > MXS_D1
c. MXS_D1 = MXS_D2

Table IV a

Test Statistics[b]

	MXS_D2 - MXS_D1
Z	-5,611[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

Table IV b

Variable X- SNM (d3)

Ranks

		N	Mean Rank	Sum of Ranks
X_SNM2 - X_SNM1	Negative Ranks	26[a]	14,12	367,00
	Positive Ranks	7[b]	27,71	194,00
	Ties	8[c]		
	Total	41		

a. X_SNM2 < X_SNM1
b. X_SNM2 > X_SNM1
c. X_SNM1 = X_SNM2

Table IV c

Test Statistics[b]

	X_SNM2 - X_SNM1
Z	-1,597[a]
Asymp. Sig. (2-tailed)	,110

a. Based on positive ranks.
b. Wilcoxon Signed Ranks Test

Table IV d

Variable SNM (d4)

Table IV. e-h

Ranks

		N	Mean Rank	Sum of Ranks
SNM2 - SNM1	Negative Ranks	0[a]	,00	,00
	Positive Ranks	37[b]	19,00	703,00
	Ties	4[c]		
	Total	41		

a. SNM2 < SNM1

b. SNM2 > SNM1

c. SNM1 = SNM2

Table IV e

Test Statistics[b]

	SNM2 - SNM1
Z	-5,369[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Table IV f

Variable PIRIFORM APERTURE(d5)

Ranks

		N	Mean Rank	Sum of Ranks
APERTURE2 - APERTURE1	Negative Ranks	0 [a]	,00	,00
	Positive Ranks	41 [b]	21,00	861,00
	Ties	0 [c]		
	Total	41		

a. APERTURE2 < APERTURE1

b. APERTURE2 > APERTURE1

c. APERTURE1 = APERTURE2

Table IV g

Test Statistics[b]

	APERTUR2 - APERTUR1
Z	-5,631[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Table IVh

Table IV. i-j

Ranks

		N	Mean Rank	Sum of Ranks
SNI2 - SNI1	Negative Ranks	21[a]	12,64	265,50
	Positive Ranks	3[b]	11,50	34,50
	Ties	17[c]		
	Total	41		

a. SNI2 < SNI1

b. SNI2 > SNI1

c. SNI1 = SNI2

Table IV i

Test Statistics[b]

	SNI2 - SNI1
Z	-3,410[a]
Asymp. Sig. (2-tailed)	,001

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Table IV j

On the other hand the variable length of the superior tract of the nasal septum demonstrates that there is no significant difference (p-value = 0.11) before and after RPE therapy.

DISCUSSION

The stenosis of the ethmoidosphenoidal subcribriform chamber becomes a "trigger" in the haemoangiokonetics of the endoexocranial anastomotic circulation; because it is fundamental to bypass the pain threshold mechanism of the apparently autonomous central disnociceptive biorhythms of these headache syndromes.

As reported in the literature, headache symptoms disappear after surgical removal of the peripheral rhinogenous trigger.[9,10]

Facial pain syndrome secondary to sinonasal pathology is reported in the International Headache Society classification (1988). One of the most difficult problems in dealing with patients with sinonasal headaches is the definition of the primary cause of the pain. Giacomini[11] reports his experience with a group of 34 patients suffering from facial pain and nasal obstruction due to septoturbinal contact and unresponsive to medical therapy. Patients free from sinus diseases or other causes of headache were treated by septoplasty/rhinoseptoplsty and middle turbinate electrocauterization. Results indicate that the septoplasty and turbinate decongestion are acceptable surgical options to treat this type of facial pain.

After performing rapid palatal expansion in the study sample, postero-anterior radiographs showed a constant and important increase in the values related to both skeletal and dental structures. This increase became gradually less marked when proceeding towards superior levels, confirming the existence of a rotation centre located in the etmoidal region between the ages of 5 and 8, and near the fronto-nasal suture after this period.

The palatal expansion created a wide interincisor diastema, that resolved spontaneously during maintenance. This expansion aims at decompressing the neurovascular structure of the subcribrose chamber in growing patients.

Rhinomanometry results: subjects considered as mouth breathers during clinical examination had significantly higher mean nasal resistances before treatment than nasal breathers. After rapid palatal expansion, a significant reduction of the mean nasal resistance compared to the pre-treatment conditions was observed.

The transverse diameter of the piriform aperture increased (mean +2.5) in all subjects; resulting in an increase in the upper airways patency and a consequent decrease in resistance to the passage of air.

After palatal expansion, headache symptoms suddenly disappeared in 32 patients, and were reduced in both, intensity and rate in 9 patients.

The first control group showed the same increase of transverse cephalometric parameters after rapid palatal expansion and a constant rhinomanometric decrease of mean nasal resistance.

Following pharmacological therapy the second control group experienced improvement in pain but not in the number of migraine episodes. Postero-anterior radiographs and rhinomanometry after 6 months did not vary. Therefore, we believe that the only realistic prophylaxis is to be performed through orthognatodontics; considering the adjustment of these dysmorphosis through an early diagnosis and a subsequent morphofunctional correction between 6 and 12 years of age. The goal therefore, should be to broaden the transverse diameters of the nasal pyramid and to decompress the neurovascular structures of the vault.

In clinical practice, the anterior active rhinomanometry[8,12] with vasoconstriction test was found extremely useful to: (1) quantify the exact extent of nasal obstruction in the oral breathers with programmed rapid palatal expansion, and (2) verify the decompression of nasal structures after therapy.

CONCLUSIONS

The results of this study confirm the validity of rapid palatal expansion to increase the transverse diameters of upper maxilla (dental arches and upper airways) in the 250 subjects with anatomical skeletal stenosis (41 from the study group and 179 from first control group). It also improves nasal respiratory function in mouth breathers, with a significant reduction in nasal resistance values. The outcomes show that the effect of treatment on headache symptoms can be attributed to rapid palatal expansion. The innovative finding of this study is the possibility to remove neurovascular compression, stasis and the tissue hypoxia, responsible for rhinogenous triggering in primary headache. This non-invasive alternative can reduce the use of pharmacological and surgical therapies in growing patients.

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