Journal of Cranio-Maxillo-Facial Surgery 42 (2014) 966–975

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Significance of distraction osteogenesis of the craniomaxillofacial skeleton – A clinical review after 10 years of experience with the technique

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ARTICLE INFO

Article history:
Paper received 1 August 2013
Accepted 3 January 2014

Keywords:
Distraction osteogenesis
Craniomaxillofacial skeleton
Significance

ABSTRACT

Introduction: Distraction osteogenesis (DO) has been applied to the field of craniomaxillofacial surgery for more than two decades. Although relevant factors for successful distraction osteogenesis are well known there are ongoing controversies about indications and limitations of the method and there is still a lack of evidence based data.

Since 2003 the principle of gradual lengthening has been applied to patients affected by different types of skeletal craniomaxillofacial deficiency within individualized treatment protocols at the Campus Virchow Klinikum – Charité Universitätsmedizin Berlin – by the same surgical team. The records of these patients were reviewed in order to assess the significance of the technique within the spectrum of a craniomaxillofacial department.

During 10 years DO has been applied in 80 patients representing less than 1% of all patients that have been treated since 2003. Review of the protocols showed a heterogeneous group with a wide variance of parameters, the age ranging from 2½ to 51 years. Internal distraction devices were used in all cases and individually selected with respect to optimal stability during active distraction and consolidation phase. Although distraction related complications occurred the majority of procedures ended up with the favoured result and skeletal stability. However additional reconstructive surgery was required despite successful distraction in the majority of patients.

Although DO has a low significance with respect to overall patient counts the method is a powerful tool within individual therapeutic concepts for the surgical correction of craniofacial anomalies that are characterized by skeletal deficiencies and should be seen as addendum to other surgical options. Predictable and stable results can be expected if the basic principles of the method are regarded.

1. Introduction

Distraction osteogenesis (DO) has been increasingly applied to the craniofacial skeleton since McCarthy reported about his experiences concerning the gradual lengthening of the human mandible in 1992 (McCarthy et al., 1992). Ilizarov who developed the technique initially in order to cure complicated fractures of the extremities systematically investigated and described the so called "tension stress effect" when gradual expansion of bone and surrounding tissues is effectuated under appropriate conditions and he finally refined the method for limb lengthening (Ilizarov, 1989a, b). However there have been already successful attempts to correct growth restrictions of the maxillofacial skeleton by comparable techniques considerably earlier (Honig et al., 2002). Preliminary experimental studies concerning mandibular lengthening have been published already in 1973 by Snyder et al., (1973). Although distraction osteogenesis nowadays has gained wide acceptance within the craniomaxillofacial community and is applied all over the craniofacial skeleton (McCarthy et al., 2001; Bell and Guerrero,

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http://dx.doi.org/10.1016/j.jcms.2014.01.018
1010-5182/

Region	Pathology / Indication	Type of DO	Number of procedures (n=87)	Growing skeleton	Internal device	Consolidation time	DO-Length	Follow up (months)	Stability	Additional surgeries	Patients assessment Would you do it again ?	Surgeons assessment Would we do it again ?	Comments
Craniofacial & Midfacial DO (n=70)	Midfacial retrusion in Craniofacial Dysostosis	Frontofacial Advancement	5	5	1x Synthes 1x KLS Riediger 3x KLS Marchac	> 6 months	++	> 24	++	+	4x++ 1x(-) severe soft tissue infection	4x++ 1x(-)	Residual growth Staged surgery
	Anophtalmia Tessier 4 cleft	Orbita	4	4	Osmed Sphere	> 6 months	++	< 24	++	+	++	+ +	Residual growth Staged surgery
	Median Craniofacial Cleft Syndrome	Nasal dorsum	1	-	KLS Track 1+ 15mm	> 6 months	++	<12	promising	+	++	+ +	Staged surgery
	Transverse maxillary deficit	TPD – bone borne	43 34 regular 5 unilat.LeFort I 4 pediatric TPD	4	1x Titamed 41x Surgitec	> 6 months	++	> 24	++	+	++	+ +	Secondary orthognathic surgery
	Transverse maxillary deficit	Hyrax- tooth borne	12 1 pediatric Hyrax	1	custom dental born devices	> 6 months	++	> 24	++	+	++	+ +	Secondary orthognathic surgery
	Maxillary Retrusion (BCLP)	Le Fort I	2	1	KLS-Zürich ped max Distractor	6 months	++	> 24	+	+	++	+ +	1xresidual growth 2x staged surgery
	Deficiency of premaxilla	Maxillary segment	2	-	Medartis Modus 2.0	6 months	++	< 12	promising	+	++	++	Additional surgeries
	Posttraumatic defect	Alveolar crest	1	-	1x KLS Microtrack	3 months	+	> 12	-	-	- -	- -	Compliance & management problem
Mandibular DO (n=17)	Postoperative defects after ablative surgery	Alveolar crest	6	-	6x Medartis Modus 1.5	6 months	++	> 60	++	+	+	+	Very complex & time consuming approach
	Orthognathic (Crowding)	Symphysis	2	1	1x Medartis Modus 1x Surgitec	6 months	++	> 24	++	+	++	+ +	Secondary orthognathic surgery
	Unilateral mandib. Hypoplasia/Crani of. Microsomia	Ramus unilateral	6	4	6x Medartis Modus Modular 1,5/2.0	6 months	+-	> 24	+-	+	+	+-	Additional reconstructive surgery
	Syndromal deficiency (TCS)	Ramus bilateral	1	1	Synthes CMF Distraktor	> 6 months	++	> 24	+ (partial condylar remodelling)	+	++	+ + CPAP off post DO	Additional reconstructive surgery
	Syndromal deficiency (TCS)	Corpus mand.	2	2	Medartis Modus 2.0	> 6 months	++	> 12	++	+	++	+ +	Additional reconstructive surgery

Fig. 1. Distribution and assessment of distraction procedures 2003–2013 ($n = 87$ distraction procedures in 80 patients).