

Problems, obstacles and complications with transpalatal distraction in non-congenital deformities

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SUMMARY. Introduction: The transpalatal distractor is a bone-borne device that eliminates negative orthodontic effects during and after maxillary expansion. It produces virtually parallel expansion in the coronal plane. Orthodontic appliances can be installed at an earlier date than when tooth-borne expanders are used. Our aim was to improve the technique by reviewing the difficulties encountered during applications in the past. Patients and Methods: The files of 57 patients were analyzed for problems (difficulties requiring surgical intervention), obstacles (difficulties requiring surgical intervention but not interfering with the result), and complications (difficulties not resolved at the end of the treatment). Results: Twenty-nine difficulties occurred. In 25 cases they were considered to be a ‘problem’. Nine problems were surgery related and 16 problems were related to the distraction device itself (14 episodes of loosening of the module, two instances of loss of one osteosynthesis screw). ‘Obstacles’ occurred in three cases, i.e. loosening of an abutment plate. There was only one ‘complication’: unilateral infraorbital hyposensitivity in a case of a high level corticotomy. Conclusion: The expansion goal was achieved in all patients. Loosening of the module proved to be the major cause of discomfort. The incidence of difficulties has led to a change in the design of the hardware and in the surgical protocol. © 2002 European Association for Cranio-Maxillofacial Surgery. Published by Elsevier Science Ltd. All rights reserved.

INTRODUCTION

An adequate transverse maxillary dimension is a critical component of stable occlusion and it contributes positively to smile aesthetics (Vanarsdall, 1999). Reduced arch perimeter and width, dental crowding, cross-bite and transverse maxillary hypoplasia are interrelated. Approximately 56% of the American population have mild to severe maxillary crowding and posterior cross-bite is present in approximately 9% (Profitt et al., 1998). Thus, it is not surprising that maxillary expansion was amongst the first dento-facial orthopaedic procedures to be undertaken (Angell, 1860).

Before the age of palatal suture closure, orthopaedic forces can rapidly expand the maxilla. Persson and Thilander (1978) state that great variations exist with regard to the age of functional closure of the mid-palatal suture. Once the suture is closed, rapid palatal expansion has to be accompanied by corticotomies in order to release the areas of bony resistance such as the mid-palatal suture, the zygomatic buttresses, the piriform aperture and the pterygo-maxillary junction (Lines, 1974). Today, both tooth-borne and bone-borne devices are used for surgically assisted maxillary expansion. The main advantages of TPD™, a bone-anchored device (Mommaerts, 1999) are the high-level orthopaedic force application with little tipping of the segments in the frontal plane (Pinto et al., 2001), the fact that there is no

orthodontic movement, and no relapse of the type seen with tooth-borne devices (Moss, 1968; Glassman et al., 1984; Bays and Greco, 1992), and that orthodontic alignment can start soon after the expansion.

Bony anchorage can bring about a number of complications, which have not been studied so far. The aim of this retrospective study is to investigate the problems, obstacles and complications encountered with a number of treatment modalities and hardware characteristics, and to aim for improvements.

PATIENTS AND METHODS

From April 1998 until October 2000, 57 patients (32 females and 25 males) underwent maxillary expansion with the use of the Transpalatal Distractor (TPD[®], Surgi-Tec NV, Bruges, Belgium) in the General Hospital St. Jan, Bruges. Patients operated upon in other hospitals and patients with congenital facial deformities were excluded. The ages ranged from 11 to 43 years (mean 18 years).

The indication for expansion was transverse maxillary hypoplasia, with some or all of these clinical features: skeletal and/or dental posterior cross-bite, anterior tooth crowding, V-shaped dental arch and large buccal ‘corridors’. Forty-six patients were bilaterally, 11 unilaterally expanded. In 35 cases, the transverse maxillary deficiency was part of a more complex maxillo-facial disharmony, which corroborates the findings of Rozier et al. (1988). Of these

patients, 17 showed sagittal mandibular deficiency (four with anterior open bite, four with deep bite and nine with a physiological 'overbite'). Fifteen patients had a skeletal Angle's-Class III relationship (nine with anterior open bite). Nine patients showed transverse deficiency in the anterior mandible and were treated with the symphyseal distraction osteogenesis technique. Mandibular distraction was achieved in eight with a bone-anchored device (Transmandibular Distractor—TMD[®], Surgi-Tec NV, Bruges, Belgium; *Mommaerts*, 2001) and in one with a tooth-anchored custom-made device (*Weil et al.*, 1997; *Guerrero*, 1990); all simultaneously with transpalatal distraction. Nine patients have undergone subsequent surgical correction of the residual sagittal and vertical components of their deformity.

The corticotomy technique was standard in all cases (*Mommaerts*, 1999). Since September 2000, the Colorado Tip (Colorado Biomedical Inc., Evergreen, Colorado, USA) was not used any longer for the palatal incisions. The abutment plates were placed at the level of the second premolar or of the first molar according to the planned antero-posterior expansion ratio (*Pinto et al.*, 2001; *Matteini and Mommaerts*, 2001). Also since September 2000, the distance between the centre of the holes for the osteosynthesis screws in the abutment plates decreased from 9.5 to 8 mm, after it had intermittently increased (November 1998). Early in the series, a TPD-module was fitted after 5–7 days. Since April 1999, the module was placed intra-operatively and unblocked 1 week later. In nine patients, mainly late in the series, the TPD-module was secured with a titanium or stainless-steel ligature around a second premolar. In the first 22 patients, the fixed orthodontic appliance was placed after a 3 month consolidation period. The TPD was removed after 6 months or longer. This routine was then changed to 1 1/2 months and 4 months, respectively. The mean consolidation period was 136 days (SD 53).

The patients were seen immediately and 1 week after the surgery, once or twice towards the end of the distraction period, at the end of the consolidation period and when they perceived difficulties requiring intervention. The tabulating and analysis part of the study started in November 2000 and was completed in April 2001.

The difficulties that arose during the treatment, from the surgical procedure until the end of the consolidation period were classified into problems, obstacles, and complications. According to *Paley* (1990, 1991), 'problems' in distraction represent difficulties that require no operative intervention to

resolve, while 'obstacles' represent difficulties that require an operative intervention. All difficulties that occur during the treatment that are not resolved by the end of the treatment are considered true 'complications'. Major complications require operative intervention after distraction treatment, whilst minor complications can be resolved non-operatively. Permanent complications cannot be resolved and often preclude the original goals of treatment.

RESULTS

In all 57 patients, separation of the mid-palatal suture, mobilization of the segment(s), subsequent expansion and stabilization during consolidation were successfully achieved. Uneventful completion of the distraction procedure was reached in 33 cases (58%). The difficulties encountered in the present study were related to hardware and protocol parameters (Table 1).

In 25 patients a *problem* occurred. Sixteen problems were related to the device: in 14 patients, the expansion module loosened and in two cases, an osteosynthesis screw fixing the abutment plate was extruded and not replaced. Of the 14 patients that presented with module loosening, six had their abutment plate placed at the level of the second premolar and eight at the level of the first molar. In the ones with the TPD at the level of the second premolar, one module loosened during distraction and five during the consolidation period. In the eight cases with TPD placed at the level of the first molar, five loosened during distraction and three during the consolidation phase. In two more patients, the module came untied because it became too small for the expanding maxilla. All together, the module dislocated in six patients during the distraction period. These were all young patients between 12 and 14 years of age, and two of them were mentally retarded. One patient of 16 years of age pulled her module out by chewing gum. Twice the modules slipped off the abutment plates by the end of the distraction period. These were situated at the first molar. Consequently, we resorted to Hawley and TPE retainers. The nine other problems were minor and were surgery related difficulties: three palatal ulcerations, one nasal bleeding, two wound infections and three haematomas in the cheek. All resolved with local measures and/or just observation.

Obstacles occurred in three cases with loosening of an abutment plate. In two patients the plates were positioned at the level of the first molar. In one of

Table 1 – Overview of problems, obstacles and complications, encountered in the series of 57 patients treated with TPD

Problems	Obstacles	Complications
Loosening of expansion module: 14 cases Extrusion of osteosynthesis screws: 2 cases Surgery related: 9 cases	Loosening of abutment plates: 3 cases	Infraorbital hypoaesthesia: 1 case

these, the fixation was already thought to be sub-optimal during surgery due to an impacted second molar. In one patient the plates were placed at the second premolar. This patient started 2 weeks too late with the distraction, due to a death in the family. Heavy forces had to be applied. All these three plates were replaced using local anaesthesia only.

There was one *complication*: one boy still had a hypoaesthesia of the left infraorbital nerve at the end of the distraction treatment. We assume that the high-level corticotomy, necessary to save a long canine root, was the cause of this.

DISCUSSION

Skeletal expansion without segmental tilting and without orthodontic/orthopaedic relapse or dental/periodontal damage constitutes the best treatment option when dealing with transverse maxillary hypoplasia (*Matteini and Mommaerts, 2001*). The transpalatal distractor (TPD) is an expander specially designed to meet these requirements. The force is applied high in the palatal vault. Segmental tilting in the coronal plane is therefore minimal (*Pinto et al., 2001*). As the device is bone-borne, dental relapse during and after the expansion is avoided. Periodontal ligament compression, buccal root resorption, fenestration and extrusion of teeth are not to be feared for as much as they are with tooth-anchored expanders (*Moss, 1968a,b; Timms and Moss, 1971;*

Barber and Sims, 1981; Langford, 1982; Greenbaum and Zachrisson, 1982). Distraction osteogenesis is a reliable technique for generating callus that readily ossifies and prevents relapse (*Aronson, 1991*). The present study focused on the overall morbidity of the TPD procedure, not just on the application of the TPD device to the palatal bone.

Paley (1990) classified the clinical difficulties in osteodistraction into 'problems, obstacles and complications'. While this may be a good classification when dealing with distraction of limbs, it may under rate the difficulties encountered for non-disabling deformities related to occlusion and facial aesthetics. For example, surgical re-intervention to remove an obstacle during the course of transpalatal distraction, necessitating a second general anaesthetic, should be considered a major problem, with the same impact as a major complication. No such major problem was encountered in this series. The original classification of *Paley (1990)* was therefore left unmodified.

Two types of hardware problems (sometimes related), were noted namely loosening of the distraction module and extrusion of an osteosynthesis screw. Clinically, it was felt that this problem occurred more when the TPD was placed at the level of the first molar. The palatal root makes the bony surface convex and the abutment plate might rock or the bone threads are stripped during placement. This could not be corroborated after analysis of all cases. However, posterior placement of the original plates had lead to an angulated position with a slipping

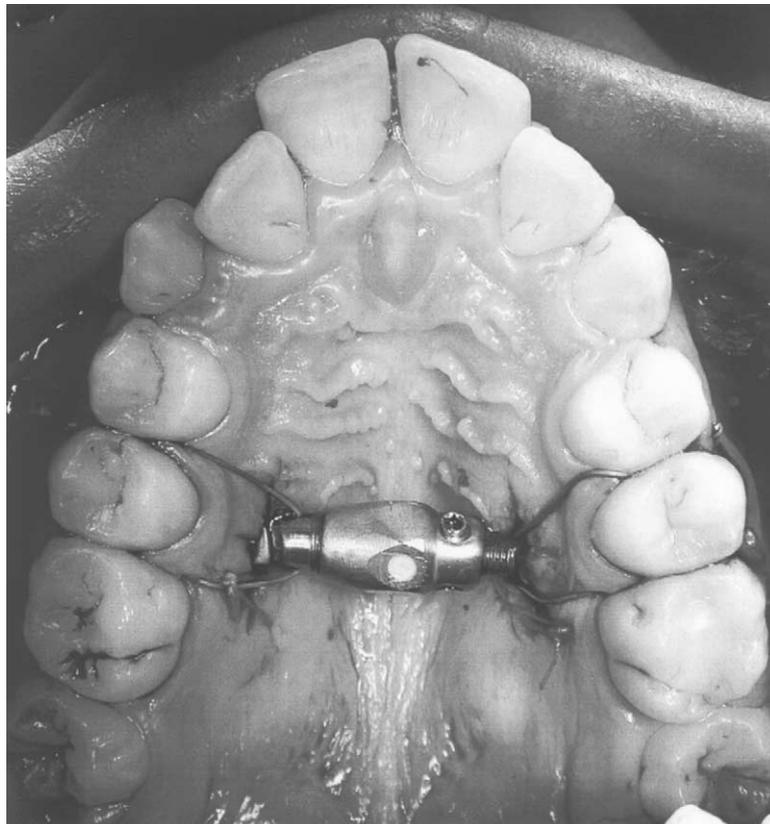


Fig. 1 – TPD-module fixed for safety reasons to the premolars with titanium ligatures.

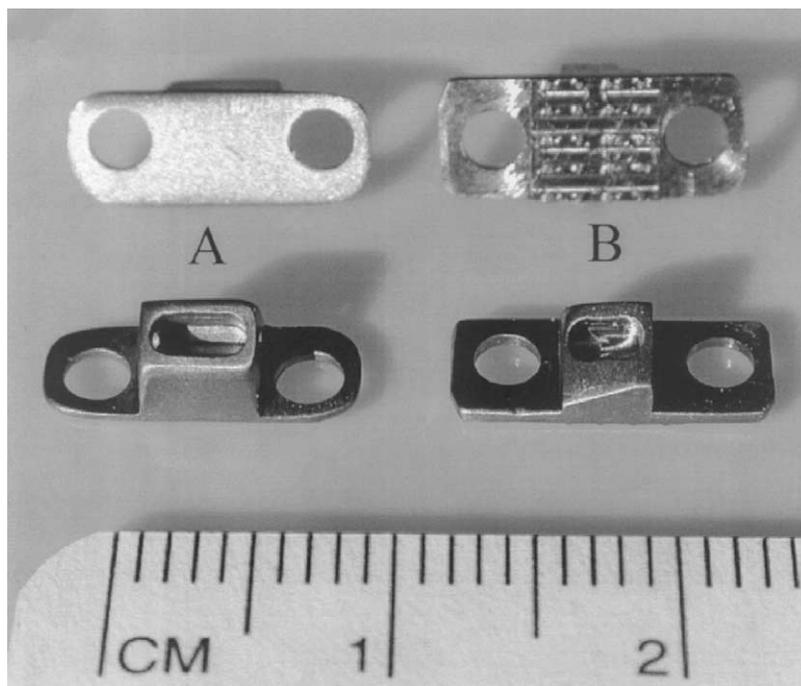


Fig. 2 – Second type of abutment plate (A) in comparison with the new one (B); the latter with double-angled box extension and spiked undersurface.



Fig. 3 – Unfixed split gastric tube drain to be removed a few hours postoperatively. This passive drain is inserted for a short distance into the lateral wounds in the buccal sulcus, until the patient is fully conscious and aware that he/she should not sneeze.

module in two patients. Towards the end of the series, the technique was altered to ligate the module around one or both second premolar(s) (Fig. 1). The manufacturer was also asked to change the design of the box on the abutment plates. These are now angled in both the coronal and axial plane, to accommodate the double-arched convexity of the palatal vault (Fig. 2). Extrusion of two osteosynthesis screws was acceptable considering the fact that monocortical screws were used (to prevent root damage). Replacement of an abutment plate because of instability was done under local anaesthesia in three patients. These obstacles were the impetus of this follow-up study. They resulted in the following adjustments: The distance between the centre of the abutment plates was decreased to better accommodate the interdental distance. The undersurface of the

plate was provided with spikes in order to increase its grip (Borgeaud et al., 2000, Fig. 2). It is important to use a drill bit of 1.65 mm as failure to adhere to this in the past, (by occasional use of a 1.8 mm drill bit) may have contributed to the instability of some abutment plates.

Surgery-related problems and obstacles were mediated: The Colorado electric cutting tip had to do with the palatal ulcerations (atrophic wounds). Therefore, it was switched to regular #15 blades for the cross-shaped palatal incisions. Securing a double split gastric tube drain bilaterally in the horizontal wound line for 2 h (Fig. 3) prevented haematoma formation. Nasal packing controlled the nasal haemorrhage which occurred despite careful inspection for possible bleeding sites in the osseous triangle of the piriform aperture (Mommaerts, 1999). Sinusitis

and wound infection rates were low, and did not require a change in the protocol. The hypoaesthesia of the infra-orbital nerve was probably due to soft tissue retraction during surgery.

CONCLUSION

Proper expansion was obtained in all patients in whom TPD was applied. *Dental or periodontal* 'problems', 'obstacles' and 'complications' as defined by *Paley* (1990) did not occur.

Loosening of the module or of the osteosynthesis plates created most of the concern amongst patients and surgeons. Consequently, the hardware and treatment protocol were modified and a new (prospective) study set up.

ADDENDUM

Since October 2000, all patients undergoing transpalatal distraction with the modified hardware and surgical protocol, were included in a prospective morbidity study. The results were analyzed when the manuscript was returned from the reviewers (December 2001). By that time, the distraction procedure was complete and the TPD device had been removed in 27 patients, 17 female and 10 male, with a mean age at surgery of 20.4 years (range 11.2–34.1). In 12 patients pterygoid disjunction was performed. Unilateral expansion was done in four. Seven patients underwent simultaneous transmandibular distraction, and 10 patients third molar removal. Two problems and one obstacle occurred bringing the 'difficulty-free' ratio to 89%. One problem was an aphthous lesion on the palate, probably induced by the postoperative catabolic period and the local trauma. Another problem consisted of a module that was dislocated. The patient had probably been activating in the wrong direction. The obstacle consisted of a drain that had slipped into the maxillary sinus, and which had to be removed using local anaesthesia. Consequently, the bilateral small drains were replaced by a single one, spanning the midline (Fig. 3).

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