COMPARATIVE STUDY

Strain Distribution and Amount of Force Required During Pterygomaxillary Dysjunction: A Comparison of Pterygoid Versus Shark-fin Osteotome

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Abstract

Objective This study was conducted to compare the efficacy of Obwegeser's pterygoid osteotome and Laster shark-fin osteotome by measurement of strain adjacent to the pterygomaxillary suture and the amount of force required for dysjunction.

Materials and Methods Two popular instruments Obwegeser's pterygoid and shark-fin osteotome were tested on dry human skulls. The external force required for separation of the pterygomaxillary suture with these osteotomes was generated by an electronically controlled 'Instron' tester Bi-06-108. Tests were performed with pterygoid osteotome placed on one randomly chosen side and shark-fin osteotome on the other side of the same specimen. The amount of strain developed by each of these instruments was recorded using two strain gauges on the right and left lateral pterygoid plates.

Results

Instrument used	Mean force to achieve dysjunction	Mean strain developed
Pterygoid osteotome	169 N	887.66 microstrain
Shark-fin osteotome	175.5 N	677.33 microstrain

Conclusion Based on the distribution of strain, from this study, we conclude that Laster shark-fin osteotome is efficacious over Obwegeser's Pterygoid osteotome, in Le fort I osteotomy.

Keywords Le Fort I type osteotomy · Obwegeser's pterygoid osteotome · Laster shark-fin osteotome · Strain

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Introduction

Today Le Fort I type osteotomy is widely used throughout the world as a routine surgical procedure, for the correction and treatment of mid-facial deformities because thereby the maxilla can be transposed safely [1]. The standard technique includes separation of the pterygomaxillary junction before down fracturing the maxilla with a curved osteotome [2]. The forces induced during surgery, and the use of appropriate instrumentation can reduce the incidence and severity of complications associated with the technique. Indeed, there are many reported techniques and instruments used to separate the posterior aspect of the maxilla from the pterygoid plates and reduce the incidence of complications.

Fig. 1 Laster shark-fin osteotome

Fig. 2 Obwegeser's pterygoid osteotome

Fig. 3 Rosette strain gauges

The Laster 'shark-fin' osteotome is one such instrument used for separating the pterygomaxillary junction in Le Fort I osteotomy (Figs. 1, 2, 3).

Complications of Le Fort I Osteotomy

Most complications of the Le Fort I osteotomy are the result of ischaemia, which include necrosis of the maxilla and alveolus, perforation of the nasal septum and loss of tooth vitality. Non-ischaemic complications that have been described include severe haemorrhage, damage to the abducent and oculomotor nerves possibly as a result of direct injury [3].

Aims and Objective

This study was conducted to compare the efficacy of Obwegeser's pterygoid osteotome and Laster shark-fin osteotome by measurement of strain adjacent to the pterygomaxillary suture and the amount of force required for dysjunction.

Materials and Methods

Two popular instruments Obwegeser's pterygoid and shark-fin osteotome were tested on dry human skulls.

The external force required for separation of the pterygomaxillary suture with these osteotomes was generated by an electronically controlled 'Instron' tester Bi-06-108 (Fig. 4). Firstly, the skull was fixed laterally on specially prepared mould on the fixing table of the universal tester. Secondly, either of the two instruments was fitted to the cross head of the tester. The cross head was advanced at a rate of 5 mm/min to allow penetration of the instrument into the pterygomaxillary suture to achieve separation (Figs. 5, 6).

Tests were performed with pterygoid osteotome placed on one randomly chosen side and shark-fin osteotome on the other side of the same specimen. The amount of strain developed by each of these instruments was recorded using two strain gauges on the right and left lateral pterygoid plates.

Fig. 4 Insitron tester BI-06-108 **Fig. 5** Application of Obwegeser's osteotome and Laster shark-fin osteotome at pterygomaxillary disjunction

Fig. 6 Application of strain gauges

Results

Instrument used	Mean force to achieve dysjunction	Mean strain developed
Pterygoid osteotome	169 N	887.66 microstrain
Shark-fin osteotome	175.5 N	677.33 microstrain

Discussion

The pattern of principal strain distributions indicated the occurrence of a large strain at the pterygoid plate on the side of Obwegeser's pterygoid osteotome application. The amount of force required to achieve the dysjunction was less in the pterygoid osteotome group as compared to the shark-fin osteotome group. Even then the amount of strain distribution was higher in the pterygoid osteotome group as compared to the shark-fin osteotome group. The pattern of principal strain distribution suggests that there is more risk of accidental fracture of the pterygoid plates separated with the pterygoid osteotome. Especially large compressive strain with the Obwegeser osteotome suggests that the pterygoid plate is strongly compressed posteriorly. In fact, Dupont et al. pointed out a possible risk of pterygoid process displacement due to compression by an osteotome [4]. Therefore, in Le Fort I type osteotomy, the application of an Obwegeser-type osteotome requires the most scrupulous care [5].

However, clinically speaking, both osteotomes have advantages and disadvantages. For example, the design of shark-fin osteotome renders its application to the pterygomaxillary suture unexpectedly difficult. On the other hand, an Obwegeser osteotome is simple in shape and allows a wide range of angular adjustment and it seems suitable for separation of the pterygomaxillary suture. However, its wider range on the other hand is associated with the risk of applying the osteotome at an incorrect angle and this represents a disadvantage. Application of an osteotome at an incorrect angle is liable to fracture the pterygoid plates [6].

Our findings strongly support the suggestion by Obwegeser, that the handle of the osteotome should be tilted at such an angle that the blade faces obliquely in the anteromedial direction to avoid posterosuperior compression of the pterygoid plates when an Obwegeser osteotome is used for separation of the suture (Obwegeser HL (1976–1978) Personal communication to T. Iizuka in Zurich).

Conclusion

Based on the distribution of strain, from this study, we conclude that Laster shark-fin osteotome is efficacious over Obwegeser's pterygoid osteotome, in Le fort I osteotomy.

Compliance with Ethical Standards

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors. Ethical committee clearance was taken from the college ethical committee.

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