Skeletal Anchorage in Orthodontics with Mini- and Microscrews

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Introduction

Maximum anchorage is a frequent challenge in orthodontic therapy. Many devices have been introduced in order to prevent teeth used for anchorage from moving (1). Using skeletally fixed devices there will not be undesired forces on teeth that should be kept at their site and subsequently many different means of skeletal anchorage have been proposed. In 1998 Melsen described skeletal anchorage by zygomatic ligatures (2). Roberts showed in 1999 that prosthetic dental implants remained stable even exposed to continuous extra axial forces and could thereby serve as anchorage for orthodontic movements (3). Wehrbein introduced the orthosystem, a palatal implant in the midline or paramedian region of the palatum for skeletal anchorage in the maxilla (4). Mikroplates have been fixed to various structures of the facial skeleton and been connected to orthodontic mechanics (5).

In the last years mini- and microscrews (MS) were used for skeletal anchorage in order to keep the surgical impact on the patient low (6-8). However it remained unclear how reliable MS were during therapy. There were no clear guidelines for the orthodontist, which MS had to be chosen in which indication and at which time after the insertion of the MS he could expose them to orthodontic forces (9-12).

Material and Methods

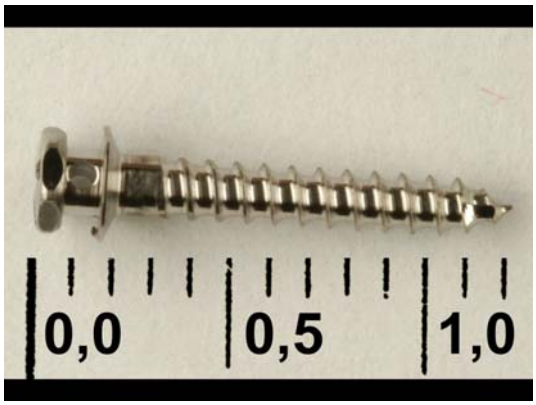
In 49 patients of an orthodontic practice one or more MS were used for skeletal anchorage. Indications for skeletal anchorage were distributed mainly to closing a gap from mesial in the maxilla and closing a gap from distal in the mandible. All other indications were of minor frequency (Table 1).

Indications

	Frequency	Percentage
Maxill. Space closure from mesial	82	61.7
Mandib. Space closure from distal	41	30.8
Maxill. Space closure from distal	4	3.0
Intrusion	4	3.0
Maxill. Distalization	2	1.5
Total	**133**	**100.0**

Table 1

The Mini- and Microimplants were purchased from two different manufacturers: AbsoAnchor by Dentos, Korea (Picture 1) and Dual Top Anchor by Jeil Medical, Korea (Picture 2). The AbsoAnchor represents a very thin, self tapping screw whereas the Dual Top Anchor is a self drilling screw of a larger diameter up to 2,0 mm.



Picture 1

Picture 2

All Implants were inserted under the same conditions by two different persons, one being an orthodontist, the other an oral and maxillofacial surgeon. All implants were loaded immediately and the clinical outcome of the patient was monitored in regular intervals. A patient questionnaire was conducted before and after surgery asking about his estimation and sensations.

All surgical procedures were worked out in the orthodontic practice.

The surgical procedure was usually carried out in correspondence to the following guidelines:
All instruments used were sterilised according to the advices of the manufacturer. After rinsing with chlorhexidine for disinfection purpose, anaesthesia was given by infiltration of only a small amount (0,2-0,5ml) of Ultracain D-S (Hoechst, Germany). Only in the palatal region of the maxilla a blocking anaesthesia of the major palatal nerve was executed.

In all cases a hole was drilled into the cortical bone by transgingival approach without flap surgery. Maximum rotation was 500 per minute and all drills were rinsed with physiological saline solution for cooling (Picture 3). The drill-diameter was chosen in correspondence to the screw to be inserted. For screw diameters of 1,3-1,6 mm we chose a drill of 0,9 or 1,0 mm. For miniscrews of 2,0 mm diameter we drilled with a diameter of 1,3 or 1,5 mm.

In the mandible drilling as well as subsequent insertion of the MS was executed in a rectangular way to the estimated bone surface not deviating more than 30°.
In the maxilla on the palatal side we used the same angulation whereas on the buccal side drilling and insertion was orientated more to the tooth axis.

Immediately after drilling the MS was inserted either by hand with a screwdriver or mechanically with a hand-piece of slow rotation. (Picture 4).

Picture 3

Picture 4

Special care was taken to insert the screw as deep as possible so that the head of the screw touched the soft tissue and no part of the thread was visible after terminating the insertion.

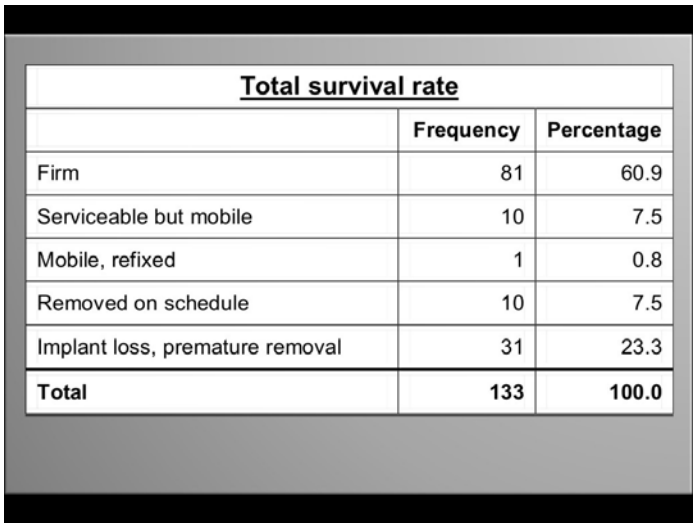
In the maxilla we usually inserted two MS for each extraction site to be closed, one on the buccal side, the other on the palatal side. In the mandible we mostly inserted only one microscrew on the buccal side for every gap.
All MS were placed into the alveolar process. We loaded the MS immediately using an elastic chain (Picture 5). Loading forces were measured and never exceeded 150cN.

Picture 5

The patient was seen in average periods of 3-4 weeks. Movements of teeth, implant stability, state of periimplant tissues and the patients restrictions were monitored at these intervals.
The implants were removed before schedule when they lacked stability and refixation seemed useless. Minimal instability was tolerated and in cases of loosening, refixation was tried by screwing the MS deeper into the bone. When the treatment goals had been achieved, the MSs were removed on schedule.

Results

The observation period ranged from 13 days to 288 days.
The total failure rate during the observation period was 23,3% (Table 2).
Although not all of the successful implants were stable (60,9 %), 0,8% could be used furthermore after refixation or supplied skeletal anchorage even with a visible mobility (7,5%).

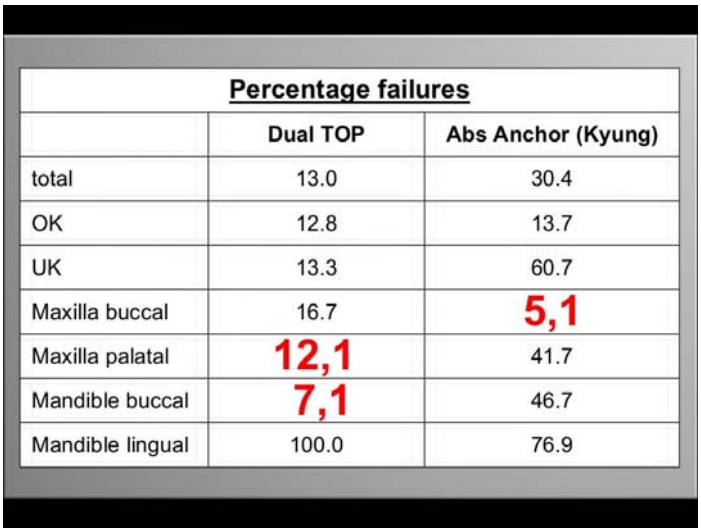


Total survival rate

	Frequency	Percentage
Firm	81	60.9
Serviceable but mobile	10	7.5
Mobile, refixed	1	0.8
Removed on schedule	10	7.5
Implant loss, premature removal	31	23.3
Total	**133**	**100.0**

Table 2

The failure rates depended highly from the design and diameter of the screw and the location where it was used (Table 3). The AbsoAnchor which was usually used in a diameter of 1,3 mm had a very low failure rate of 5,1% in the maxilla on the buccal side. In this location its failure rate was lower than that of the Dual Top Anchor (16,7%). On the palatal side of the maxilla the Dual Top Anchor had a lower failure rate of 12,1% in comparison to the thin screw (41,7%). In the mandible on the buccal side the Dual Top Anchor showed a much lower failure rate of 7,1% than the AbsoAnchor which had a failure rate of 46,7% in this location. In the mandible on the lingual side both systems showed high failure rates.



Percentage failures

	Dual TOP	Abs Anchor (Kyung)
total	13.0	30.4
OK	12.8	13.7
UK	13.3	60.7
Maxilla buccal	16.7	**5,1**
Maxilla palatal	**12,1**	41.7
Mandible buccal	**7,1**	46.7
Mandible lingual	100.0	76.9

Table 3

The patients usually tolerated the surgical procedure of the MS insertion very well. When asked, to which dental or orthodontic treatment they compared the insertion of the MS, most of the patients compared it to procedures of minor impact like having an orthodontic arch replaced or a dental filling made (Table 4).

Answer	Frequency	Percentage
Having brackets bonded	7	5.3
Having an orthodontic archwire replaced	48	36.1
Having a new filling	54	40.6
Having a tooth extracted	12	9.0
Having wisdom teeth removed surgically	2	1.5
Others	10	7.5
Total	**133**	**100.0**

Table 4

MS usually provided maximum anchorage during the period of treatment. We observed movement of teeth of about 1mm per month without loss of anchorage.
One example shall illustrate the treatment progress with the use of MS as skeletal anchorage:
A 39 year old lady appeared in the orthodontic office for correction of her malocclusion. She presented a class II relationship on the left side. A bridge on the left upper side had recently been placed and the patient did not want the pontic to be removed. So it was decided to take out the first premolar for dentoalveolar compensation of the class II relationship. (Picture 6) During treatment, loss of anchorage appeared. (Picture 7).

Picture 6

Picture 7

Two Microscrews were placed, one on the palatal side (Picture 8) and one on the buccal side (Picture 9) underneath the pontic. Space closure was continued with a buccal and a palatal elastic using the microscrews as skeletal anchorage. During this treatment period no further loss of anchorage occurred, it could even be observed that the mesially displaced bridge was moved to its former position. (Picture 10) After

removal of the microscrews a nice treatment result was achieved and remained stable. (Picture 11)

Picture 8

Picture 9

Picture 10

Picture 11

Discussion

Skeletal anchorage provided by MS placed into the alveolar process showed to be an effective tool in orthodontic treatment. High success rates could be achieved and the treatment results were improved or could be realised with less patients collaboration.
The data of other authors show success rates similar to our data (6).
By adequate selection of the screw parameters according to the site of insertion, failure rates could be further reduced and in ideal circumstances they were comparable to those of dental implants. In the maxilla on the buccal side a thin screw had higher success rates, probably because there is less space available between the roots. In other locations and especially in the mandible a thicker screw was more advantageous.
In the last years it remained unclear, if immediate loading was possible in MS anchorage. Many authors suggested an unloaded period of several weeks (13).
However we observed high survival rates even with immediate loading of the MS with orthodontical forces. This suggests, that a certain period before using the MS for therapy might not be required.
The surgical impact was usually considered as very low by our patients. Considering the data of Miyawaki who compared MS to other devices of skeletal anchorage like miniplates this seems to be a very important advantage of MS (6). As there is usually no flap-surgery swelling and bleeding will be minimal or missing at all. This should be

emphasised before treatment in order to meet the patients fear, that might be present, of any kind of surgical procedure.

Conclusion

Mini – and Microscrews used as a device for temporary skeletal anchorage in orthodontics may contribute to the efficiency of the therapy. Success rates are high and results are predictable, even when immediate loading is performed. The success rates can be optimised by careful selection of the screw characteristics according to the anatomic situation.

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