Stability of midface fracture repair using absorbable plate and screw system-pilot holes drilled and pin placement at angles other than 90 degrees

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ABSTRACT

Aim: To determine if the KLS Martin Sonic Weld™ system provides plate-screw construct stability in the midface buttresses when placed at acute angles in the midface buttresses. The Sonic Weld™ system uses an ultrasonic plate-pin system with pins placed at 90° angles. This study compares this system to currently used absorbable miniplates with screws placed at 90° in the midface buttresses.

Methods and Materials: Ten skulls were prepared by creating osteotomies in the midface buttresses bilaterally. The fractures involved the nasomaxillary buttress, the Zygomaticofrontal suture, and the Zygomatico-maxillary buttress. All fractures were created at 45, 30, 22.5, and 15 degrees. Acute angles, < 90°, were associated with worse failure loads than 90° screws, and should be safe to use in the middle third of the face.

RESULTS

A total of 57 paired tests were collected (114 total). These tests could not be included in the analysis due to a lack of failure in the test system. The failures were due to bone failure when the remaining 51 tests failed in a load of the plate-screw construct. A total of 10 ZF sutures tested, five right hemi-faces were plated at 60° and five were plated at 30°. Of the ten ZM buttresses tested, five right hemi-faces were plated at 60° and five were plated at 30°. The screws were placed at a shallow acute angle of 30°. An Instron Hounsfield (Woodward, MA) was used to apply a cyclic, quasi- static load to each fixation group. The force was increased at 0.30 ± 0.04 mm/sec up to the point of failure or until the screw became loose. The mean failure force was 355.25 ± 117.61 for the 90° group and 271.99 ± 117.61 for the 30° group. The mean failure force was 334.35 ± 148.27 for the 60° group. The mean failure force was 296.64 ± 253.22 for the 45° group. The mean failure force was 271.99 ± 240.67 for the 30° group. The mean failure force was 245.44 ± 229.14 for the 22.5° group. The mean failure force was 209.31 ± 197.91 for the 15° group. The mean failure force was 186.52 ± 160.52 for the 10° group. The mean failure force was 160.52 ± 126.80 for the 5° group. The mean failure force was 126.80 ± 98.14 for the 0° group. The mean failure force was 121.45 ± 75.00 for the control group.

CONCLUSION

Acute angles, < 90°, were associated with worse failure loads than 90° screws, and should be safe to use in the middle third of the face. This study shows that screws inserted at 90° have plate failure loads above the loads generated by the masseter muscle, and should be safe to use in the middle third of the face. This study was preclinical and using cadaver heads in controlled conditions, which may not be representative of the human case. Further study should be performed using patients in order to validate these findings in a clinical setting.

REFERENCES