INTISARI

Bilateral Sagittal Split Osteotomy (BSSO) merupakan prosedur utama dalam koreksi deformitas mandibula yang menuntut stabilitas biomekanik optimal untuk mencegah *relaps* dan gangguan penyembuhan. Variasi konfigurasi fiksasi dan kondisi pembebanan fungsional memengaruhi distribusi von Mises stress serta tekanan kontak pada sistem tulang dan implant. Penelitian ini bertujuan mengevaluasi stabilitas biomekanik tiga metode fiksasi mandibula, yaitu pelat tunggal monokortikal, pelat ganda monokortikal, dan *hybrid*, serta menentukan metode yang paling optimal melalui pendekatan numerik.

Penelitian ini merupakan studi eksperimental *in silico* menggunakan *finite element analysis* (FEA) dengan desain *Orthogonal Array Taguchi L9*. Analisis difokuskan pada distribusi *von Mises stress* dan tekanan kontak pada tulang, pelat, dan sekrup. Faktor dominan diidentifikasi melalui nilai *delta S/N ratio*, kemudian dilakukan evaluasi komparatif dan analisis multikriteria menggunakan *Analytic Hierarchy Process* (AHP) dengan *Consistency Ratio 0,03*.

Hasil menunjukkan perbedaan distribusi *von Mises stress* dan tekanan kontak antar sistem fiksasi. Pelat tunggal monokortikal memperlihatkan distribusi *von Mises stress* yang lebih terkendali dan tekanan kontak relatif lebih rendah dibandingkan pelat ganda dan *hybrid*. Gaya mastikasi merupakan faktor paling dominan (ΔS/N=8,59). Skor terintegrasi AHP menunjukkan pelat tunggal memiliki nilai tertinggi (0,68), diikuti pelat ganda (0,66) dan hybrid (0,15). Stabilitas optimal lebih ditentukan oleh keseimbangan distribusi beban daripada rigiditas maksimum sistem fiksasi.

Kata kunci: BSSO, *finite element analysis*, *von Mises stress*, tekanan kontak, stabilitas biomekanik

ABSTRACT

Bilateral Sagittal Split Osteotomy (BSSO) is a primary procedure for correcting mandibular deformities and requires optimal biomechanical stability to prevent relapse and impaired healing. Variations in fixation configuration and functional loading conditions influence the distribution of von Mises stress and contact pressure within the bone–implant system. This study aimed to evaluate the biomechanical stability of three mandibular fixation methods, single monocortical plate, double monocortical plate, and hybrid also to determine the most optimal configuration using a numerical approach.

This experimental *in silico* study employed finite element analysis (FEA) with an Orthogonal Array Taguchi L9 design. The analysis focused on von Mises stress distribution and contact pressure in bone, plates, and screws. Dominant factors were identified using delta S/N ratio values, followed by comparative evaluation and multi-criteria analysis using the Analytic Hierarchy Process (AHP) with a Consistency Ratio of 0.03.

The results demonstrated differences in von Mises stress distribution and contact pressure among fixation systems. The single monocortical plate exhibited more controlled stress distribution and relatively lower contact pressure compared to the double plate and hybrid systems. Masticatory force was identified as the most dominant factor ($\Delta S/N = 8.59$). The integrated AHP scoring indicated that the single plate achieved the highest score (0.68), followed by the double plate (0.66) and hybrid system (0.15). Optimal stability was determined to depend more on balanced load distribution than on maximum structural rigidity of the fixation system.

Keywords: Mandibular fixation, BSSO, finite element analysis, von Mises stress, contact pressure, Taguchi design