

## ABSTRAK

**BIOMEKANIKA *SHEAR STRENGTH* DAN MODULUS ELASTISITAS  
PADA DEFEK KARTILAGO MANDIBULA PASCA IMPLANTASI  
DENGAN *HUMAN UMBILICAL CORD MESENCHYMAL STEM CELLS*  
DAN *PLATELET RICH FIBRIN SCAFFOLD*  
(Penelitian Eksperimental Laboratorik *In Vivo*  
pada Defek Kartilago Mandibula Kelinci)**

**Latar Belakang:** Cedera kartilago artikularis disebabkan oleh degenerasi progresif trauma atau mekanik menyebabkan nyeri sendi, pembengkakan, berakibat pada hilangnya fungsi sendi, dan akhirnya osteoarthritis. Jaringan artikularis memiliki kemampuan regenerasi yang terbatas sehingga mempersulit pendekatan terapi. Rekayasa jaringan kartilago menggunakan *mesenchymal stem cells* dan *platelet rich fibrin scaffold* saat ini telah dipertimbangkan sebagai perawatan alternatif yang menjanjikan untuk cedera kartilago artikularis.

**Tujuan:** Melakukan evaluasi biomekanika *shear strength* dan modulus elastisitas pada defek kartilago mandibula pasca implantasi dengan *hUCMSC* dan *PRF scaffold*.

**Metode:** Defek kartilago kondilus mandibula kanan bagian anterior dibuat pada 40 *New Zealand White Rabbits* jantan. Sampel dibagi menjadi 4 kelompok uji *shear strength* dan 4 kelompok uji modulus elastisitas (3 kelompok eksperimen dan 1 kontrol). Kelompok eksperimental diberikan perlakuan dengan *hUCMSC*, *PRF scaffold*, atau kombinasi *hUCMSC* yang dilakukan *seeding* pada *PRF scaffold*. Grup kontrol dibiarkan tanpa perlakuan. Terminasi dilakukan setelah 4 minggu, kemudian dilakukan uji biomekanika *shear strength* dan modulus elastisitas. Analisis statistik menggunakan ANOVA *test*, yang dikatakan signifikan bila  $p < 0,05$ .

**Hasil:** Hasil uji biomekanika *shear strength* dan modulus elastisitas menunjukkan kelompok *hUCMSC* ( $1,162 \pm 0,090$  dan  $8,700 \pm 1,502$ ) dan kelompok kombinasi ( $0,728 \pm 0,071$  dan  $7,742 \pm 0,814$ ) memiliki nilai lebih tinggi daripada kelompok *PRF* ( $0,108 \pm 0,032$  dan  $0,520 \pm 0,282$ ) dan kelompok kontrol ( $0,096 \pm 0,037$  dan  $2,956 \pm 1,623$ ) dengan perbedaan rata-rata yang signifikan  $p = 0,014$  dan  $p = 0,000$ .

**Kesimpulan:** Implantasi *hUCMSC* atau *hUCMSC* yang dilakukan *seeding* pada *PRF scaffold* adalah metode baru untuk regenerasi kartilago mandibula, yang menunjukkan biomekanika *shear strength* dan modulus elastisitas yang lebih baik.

**Kata Kunci:** Biomekanika, *shear strength*, modulus elastisitas, defek kartilago mandibula, *human umbilical cord mesenchymal stem cells*, *platelet rich fibrin scaffold*

**ABSTRACT****BIOMECHANICS OF SHEAR STRENGTH AND MODULUS OF ELASTICITY IN MANDIBLE CARTILAGE DEFECT AFTER IMPLANTATION WITH HUMAN UMBILICAL CORD MESENCHYMAL STEM CELLS AND PLATELET RICH FIBRIN SCAFFOLD  
(In Vivo Laboratory Experimental Study on New Zealand White Rabbit)**

**Background:** Articular cartilage injuries caused by traumatic or mechanical progressive degeneration result in joint pain, swelling, the consequent loss of joint function, and eventually osteoarthritis. Articular tissue possesses a limited ability to regenerate that further complicates the therapeutic approaches. Cartilage tissue engineering using mesenchymal stem cells and platelet rich fibrin scaffold have been considered nowadays as a promising alternative treatment for articular cartilage injuries.

**Objective:** To investigate the biomechanics of shear strength and elastic modulus in mandible cartilage defect after implantation of hUCMSC and PRF scaffold.

**Materials and Methods:** Cartilage defects were created on anterior right mandible condyles of 40 male New Zealand White Rabbits. The samples were divided into 4 groups of shear strength test and 4 groups of elastic modulus test (3 experimental and 1 control group). Experimental group were treated with hUCMSC, PRF scaffold, or combination of hUCMSC seeded on PRF scaffold. Control group was left empty. All groups were terminated after 4 weeks of observation period, then biomechanical testing of shear strength and elastic modulus was conducted. Statistical analysis was carried out using ANOVA test, with a significance level of  $p < 0,05$ .

**Results:** Biomechanical testing results of shear strength and elastic modulus showed that hUCMSC ( $1,162 \pm 0,090$  and  $8,700 \pm 1,502$ ) and combination groups ( $0,728 \pm 0,071$  and  $7,742 \pm 0,814$ ) have higher values than PRF ( $0,108 \pm 0,032$  and  $0,520 \pm 0,282$ ) and control groups ( $0,096 \pm 0,037$  and  $2,956 \pm 1,623$ ) with a significant difference of mean  $p = 0,014$  and  $p = 0,000$ .

**Conclusions:** Implantation of hUCMSC or hUCMSC seeded on PRF scaffold is a novel method for mandible cartilage regeneration, and they showed a better biomechanics of shear strength and elastic modulus.

**Keywords:** Biomechanic, shear strength, modulus of elasticity, mandible cartilage defect, human umbilical cord mesenchymal stem cells, platelet rich fibrin scaffold