

## Objective

Implant-based dentures are a growing treatment option. Due to the rigid fixation afforded by implant structures, the risk of prosthesis fracture is increasing. This risk can be mitigated by the application of toughness-modified material. This study deals with the fracture toughness and strength of four injection-based denture base materials.

## Materials and Methods

|                               | Batch-No.                           | Classification acc. EN ISO 20795-1 |                 | Manufacturer     |
|-------------------------------|-------------------------------------|------------------------------------|-----------------|------------------|
|                               |                                     |                                    |                 |                  |
| <b>Lucitone 199 / Success</b> | Polymer: 110112<br>Monomer: 1011233 | heat-polymerizable                 | Type1, Class1   | Dentsply         |
| <b>PalaXpress ultra</b>       | Polymer: 012001<br>Monomer: 010100  | auto-polymerizable                 | Type 2, Class 1 | Heraeus Kulzer   |
| <b>PalaXpress</b>             | Polymer: 010157<br>Monomer: 010488  | auto-polymerizable                 | Type 2, Class 1 | Heraeus Kulzer   |
| <b>IvoBase High Impact</b>    | NM0157                              | auto-polymerizable                 | Type 2, Class 1 | Ivoclar Vivadent |

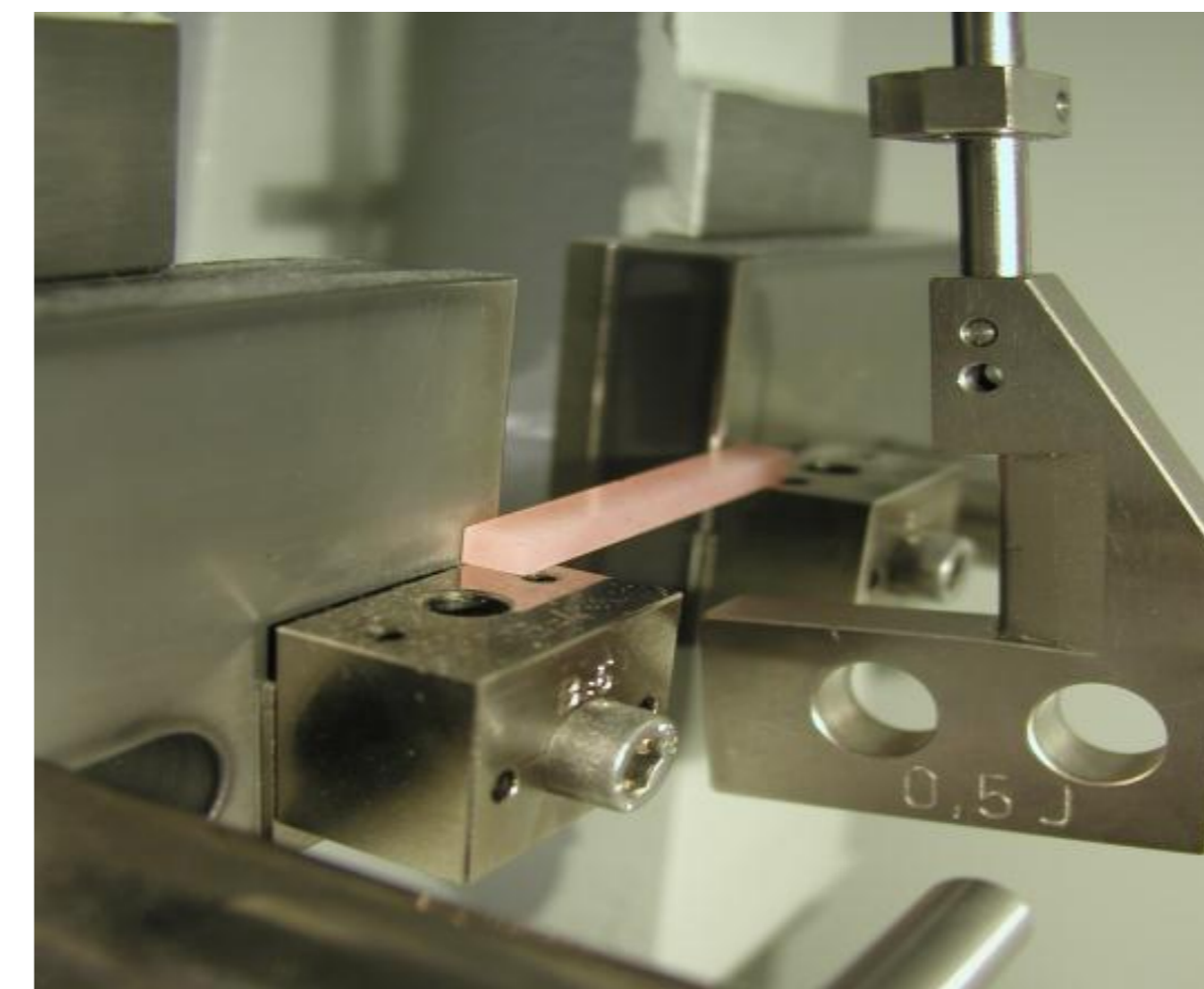


Figure 1: Test set-up for the Charpy notched impact strength

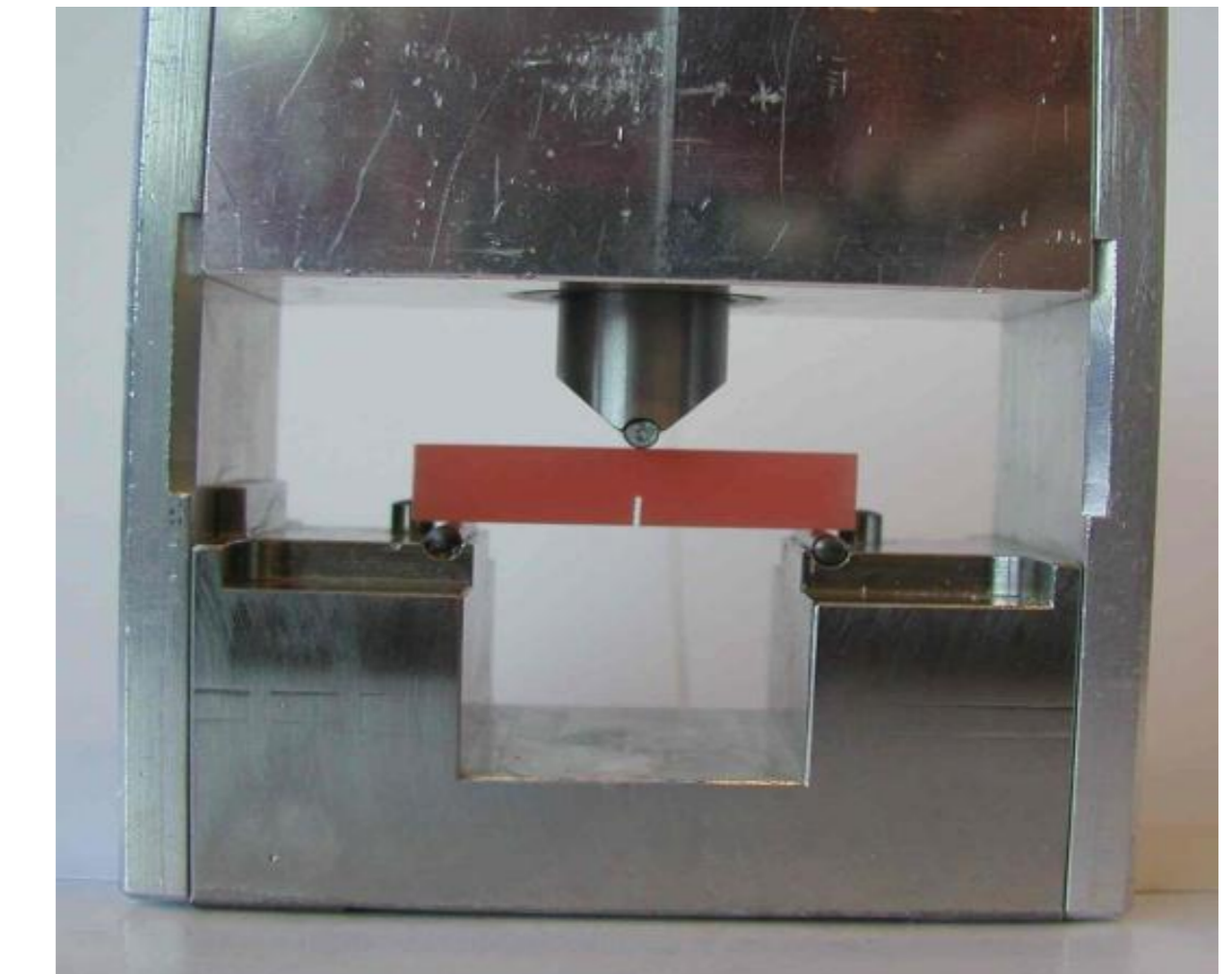


Figure 2: Test set-up for fracture toughness measurements

Four different injection-based denture systems (Lucitone 199 – heat-curing / Dentsply; PalaXpress, PalaXpress ultra – auto-curing / Heraeus Kulzer; IvoBase High Impact – new acrylic system from Ivoclar Vivadent) were studied. The fracture toughness  $K_{max}$ , fracture work  $W_f$ , flexural strength and the flexural modulus were determined in accordance to ISO 20795-1:2008. The Charpy notched impact strength was investigated according to the former standard ISO 1567:2000 AM1.

The data were analyzed using the multi-comparison Dunnett-T3 test.

## Results

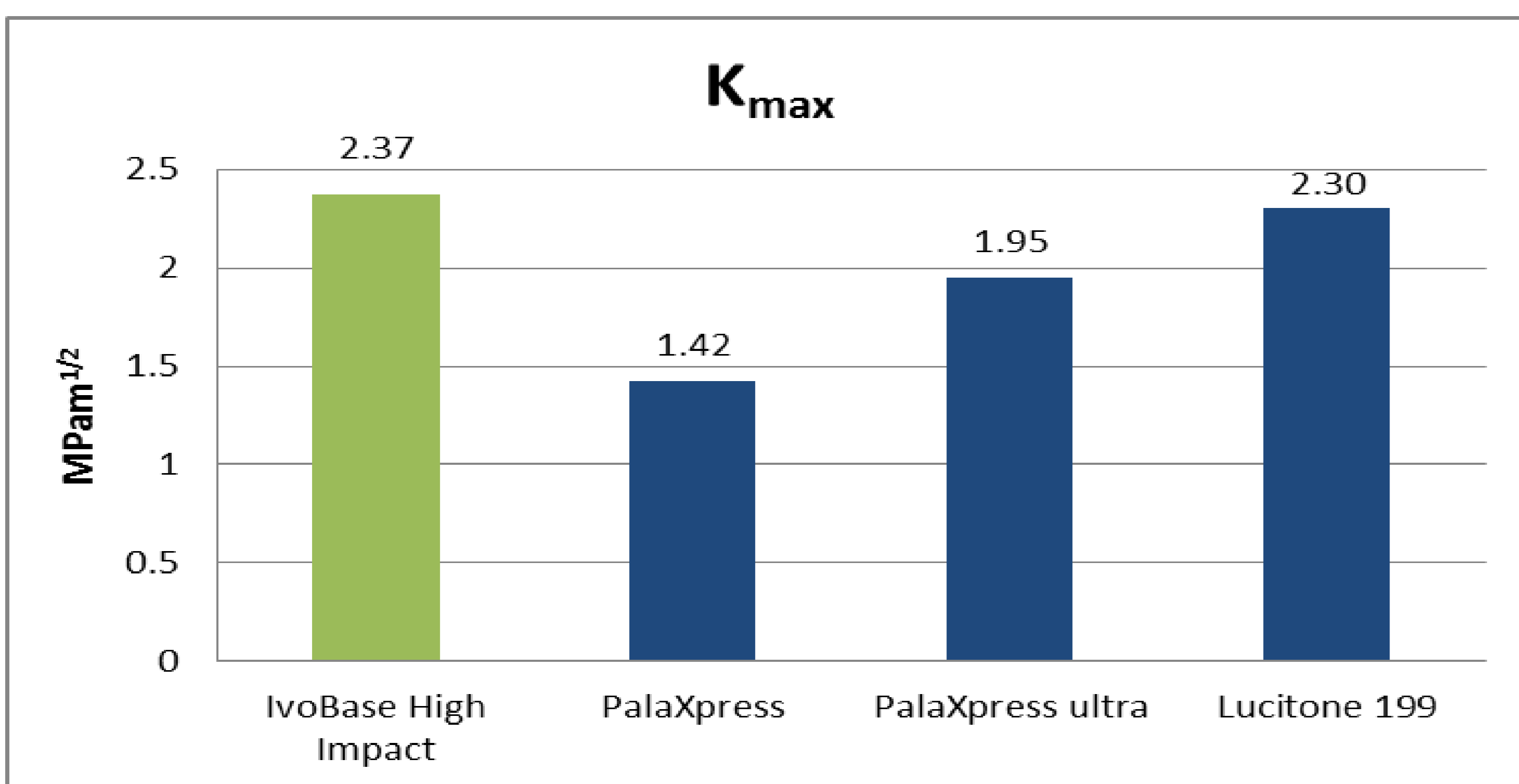


Fig. 3: Fracture toughness of four injection-based denture systems

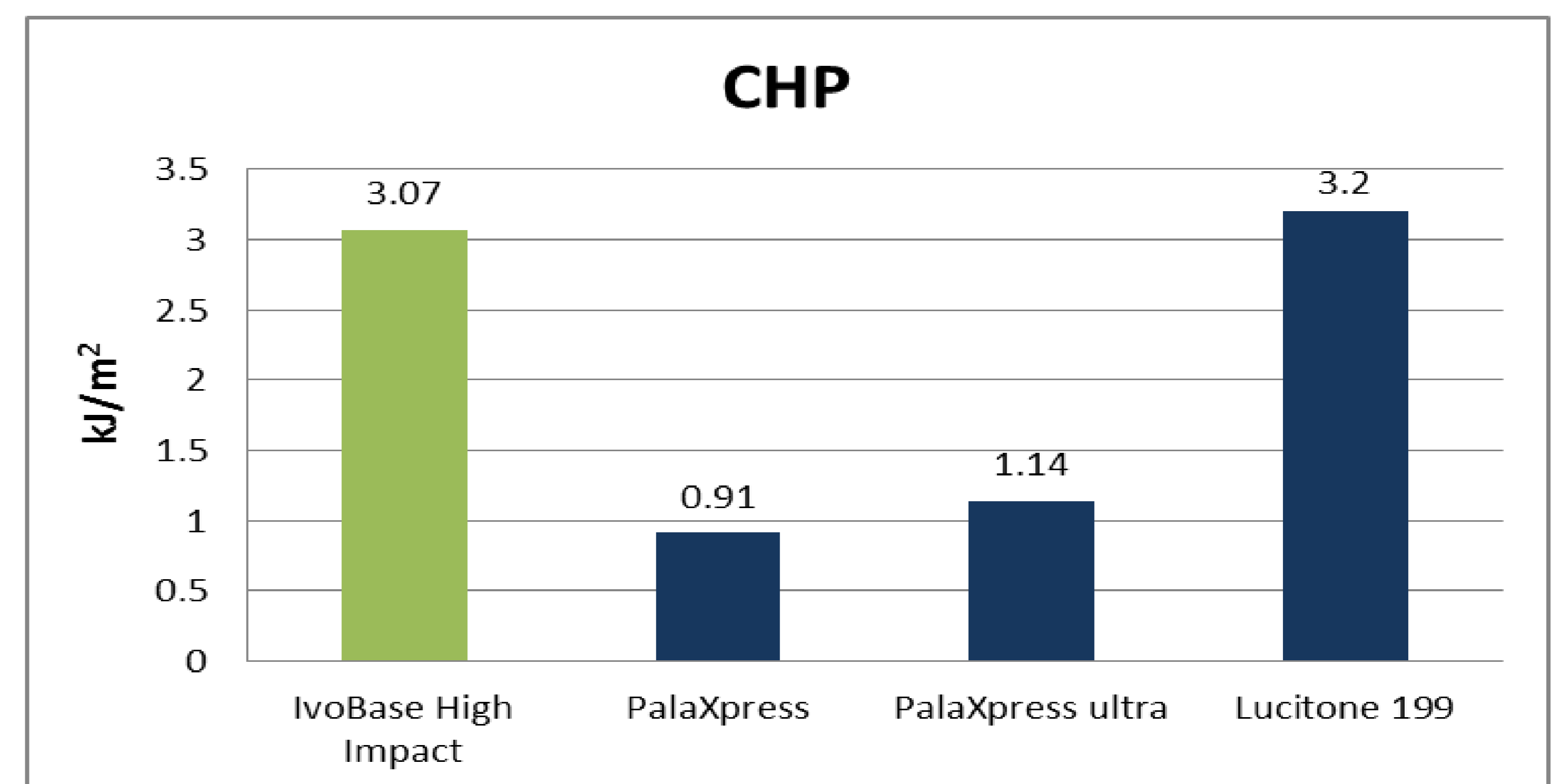


Fig. 4: Charpy notched impact strength of four injection-based denture systems

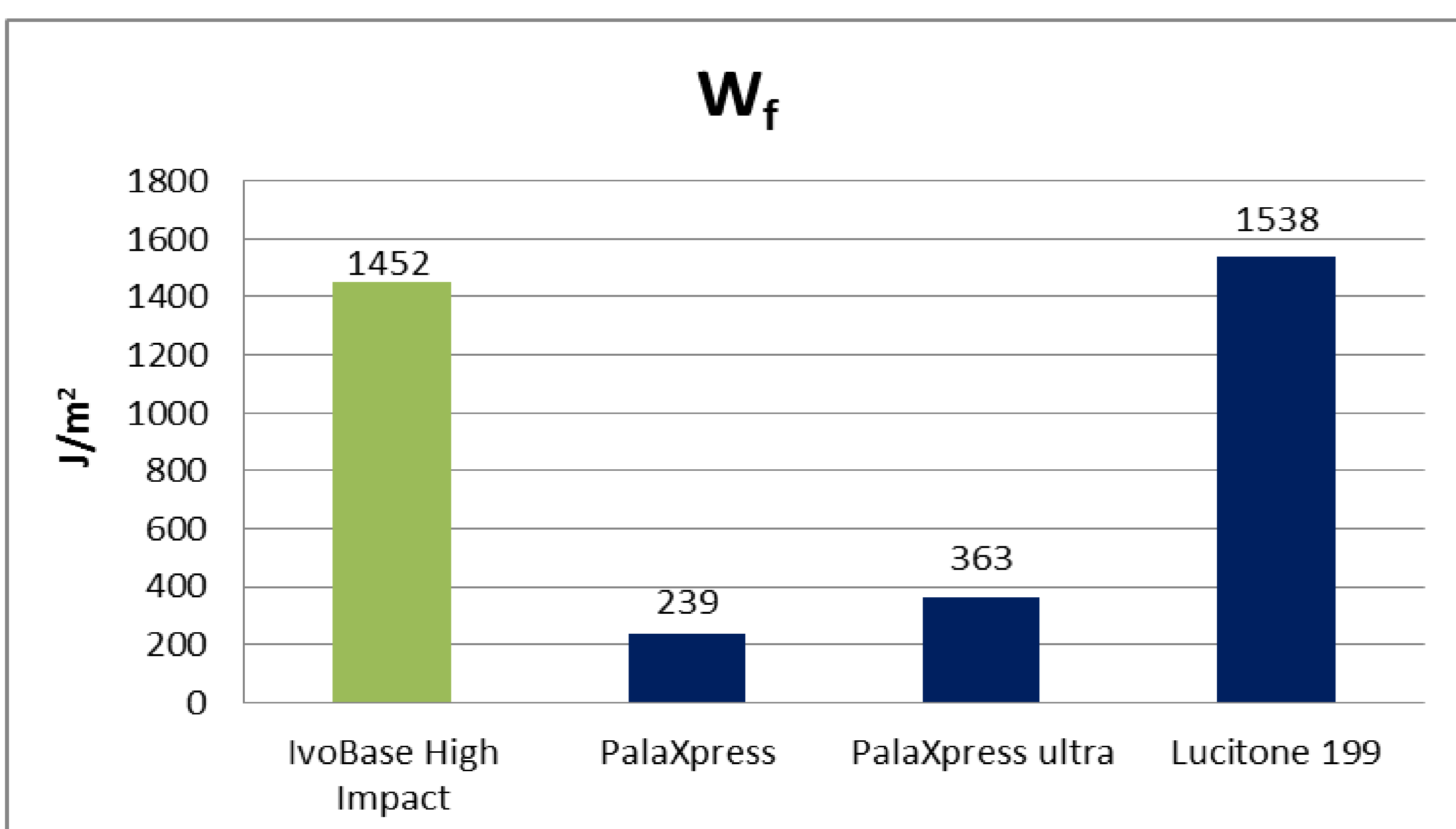


Fig. 5: Fracture work of four injection-based denture systems

|           | Material            | IvoBase High Impact |      | PalaXpress |      | PalaXpress ultra |      | Lucitone 199 |      |
|-----------|---------------------|---------------------|------|------------|------|------------------|------|--------------|------|
|           |                     | Average             | SD   | Average    | SD   | Average          | SD   | Average      | SD   |
| $K_{max}$ | MPam <sup>1/2</sup> | 2.37                | 0.07 | 1.42       | 0.05 | 1.95             | 0.16 | 2.30         | 0.06 |
| $W_f$     | J/m <sup>2</sup>    | 1452                | 57   | 239        | 11   | 363              | 48   | 1538         | 46   |
| CHP       | kJ/m <sup>2</sup>   | 3.07                | 0.16 | 0.91       | 0.06 | 1.14             | 0.30 | 3.20         | 0.09 |
| $\sigma$  | MPa                 | 73.8                | 2.0  | 75.9       | 1.5  | 73.4             | 3.2  | 77.7         | 6.5  |
| E         | MPa                 | 2361                | 53   | 2735       | 33   | 2596             | 18   | 2457         | 268  |

Table 1: Comparison of different mechanical properties of four injection-based denture systems

## Conclusions

IvoBase High Impact and Lucitone 199 significantly exceed the limits for high-impact denture base material according to ISO 29795-1:2008 ( $K_{max} > 1.9$  MPam<sup>1/2</sup>,  $W_f > 900$  J/m<sup>2</sup>). In the measurements PalaXpress ultra, which is called impact-resistant by the manufacturer, did not reach the required value. As an example of a non-high-impact-modified denture system PalaXpress is as expected below the standard limits. The same order is reflected in the values for the Charpy Notched Impact Strength. All of the tested denture materials fulfill the requirements for flexural strength and flexural modulus.