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**中文摘要:** 牙齒脫落是造成牙齒主要傷害的原因之一。將脫落的牙齒重植回口內常會遇到的問題是嚴重發炎，以及牙根吸收及取代性吸收而造成與牙槽骨僵直性黏結的現象，前者是由於感染所致，後者則是由於牙周韌帶及牙骨質受損而造成。一般相信有健康的牙骨質及牙周膜應不會有僵直性黏結的現象，目前要避免在植入後有僵直性黏結的發生，建議最好的方式是在植入前能適當的保存牙齒。

不同的保存液可能都有促進牙周膜存活的機會。然而，對於牙周膜嚴重受損的牙齒至今仍無法有突破性的改善。隨著組織再生技術的發展，許多不同的組織包括牙周組織陸續被研究再生的可行性；最近有關牙周幹細胞的發現更提供我們對於較長時間暴露於乾燥或其他不良環境的脫落牙齒有達到牙周膜再生的可能性。牙周幹細胞在迷你豬的動物模式上已被報告可促進牙周破壞組織的再生，另有報告在豬的顎骨中於人工牙根周圍可形成類似牙周組織的報告，基於這些研究我們可以推論，利用牙周幹細胞可在脫落牙齒上得到牙周膜的再生。為了證實這個假說，我們利用已建立的模式，在裸露的牙根表面使之形成牙周膜，主要的目的是以體外及體內模式分離並鑑定牙周幹細胞，自人的牙齒分離牙周幹細胞並以標準方式鑑定其

幹細胞的特性，另外利用牙周幹細胞置於牙根碎片上置入不具免疫排斥性的老鼠皮下組織中觀察異位牙周膜的形成。以組織切片及組織免疫化學染色分析牙周膜的再生情形。

本研究提供在體外培養牙周幹細胞促進脫落牙牙周再生的可能性之證據，將進一步以實際脫落牙進行實驗，相信對脫落牙長期有效的存活將有極大的助益。

**外文摘要:** One of the most serious injuries of teeth is avulsion. Two adverse outcomes that are frequently observed after replantation are severe inflammatory resorption and replacement resorption (ankylosis). The former is caused by infection and the latter the result of damaged periodontal ligament (PDL) and cementum. It has been considered that with the presence of healthy cementum and PDL, ankylosis should not occur. Currently, the advocated protocol that can reduce the chance of ankylosis after replantation is the proper storage of the avulsed teeth before the replantation can take place. Various types of storage media that may enhance the survival of PDL have been tested and new media are continuously being investigated. However, there has been no significant breakthrough in the salvage of the avulsed teeth with severely damaged PDL. With the advent of tissue engineering technologies, various types of tissues are being tested for regeneration including PDL. Additionally, recent discovery of human periodontal ligament stem cells (hPDLSCs) provides us a possibility of regenerating PDL of avulsed teeth subjected to prolong exposure to dry or other adverse environments. PDLSCs have been recently shown to enhance the regeneration of periodontal defects in a minipig model. In another application, PDL-like tissue around an engineered bio-root is formed in minipig's jaws. Based on these premises, we hypothesize that using PDLSCs, PDL can be regenerated in vivo on avulsed teeth.

PDLSCs from teeth of human and their stem cell properties were determined using standard protocols. Ectopic formation of PDL on human teeth was tested by transplanting the root fragment seeded with PDLSCs into the subcutaneous space of immunocompromised mice. After 6 weeks, the samples were resected from mice and subjected to histological and immunohistochemical analyses. The regeneration of PDL was examined using histological and immunohistochemical analyses.

In our results, regeneration of periodontal ligament on the fragments of tooth was found. This study provides the possibility of renew PDL of an avulsed tooth using ex vivo expanded PDLSCs. Further study using animal model for avuled teeth is necessary. This is a first step toward a breakthrough in the management and treatment of avulsed teeth with a more favorable long-term outcome.