

Short communication

Characterization of prematurely failed stainless steel orthopedic implants

S.S.M. Tavares^{a,*}, F.B. Mainier^b, F. Zimmerman^a, R. Freitas^a, C.M.I. Ajus^a^a Universidade Federal Fluminense, PGMEC, Rua Passo da Pátria, 156, CEP 24210-240 Niterói, Brazil^b Universidade Federal Fluminense, Departamento de Engenharia Química, Rua Passo da Pátria, 156, CEP 24210-240, Niterói, Brazil

ARTICLE INFO

Article history:

Received 22 November 2009

Received in revised form 5 February 2010

Accepted 7 February 2010

Available online 11 February 2010

Keywords:

Implants

Fatigue

AISI 316L

1. Introduction

Metallic surgical implants are structural components used to accelerate the bone consolidation after fracture. A group of implants consist of compression plates fixed to the bone by bolts and nuts. This is particularly useful when the excessively long period of consolidation by traditional methods (without implants) would probably provoke the atrophy of cartilages and articulations of the human body.

In recent years, many researches have been made to study the behavior of metallic surgical implants in order to improve the biocompatibility of metals and alloys used in osteosynthesis implants. Surgical implants are submitted to aggressive working conditions such as static and dynamic mechanical loading and exposed to the biochemical and dynamic environments of the human body, that contributes to accelerate wear. The load on implant varies with position in walking cycle and reaches a peak of about four times the body weight at the hip and three times the body weight at the knee. Larger loads are assumed by the hip and knee joints during activities such as running and jumping [1–4].

Austenitic stainless steel has been widely used as osteosynthesis implants because of the excellent mechanical properties, corrosion resistance and cost benefit. Therefore, the high chloride concentration plus the regular temperature of the human body might create localized corrosions like pitting, crevice corrosion and fretting fatigue [5].

The study of failure analyses help developing better implant devices. In this work seven orthopedic surgical implants which failed in service were evaluated. The implants are made of austenitic stainless steel, and were used in Brazilian patients assisted by the national public health system (SUS). Fig. 1a shows a radiographic pattern of a compression plate implant fractured under service, before the bone recuperation. Fig. 1b shows the same implant after being removed and cleaned for analysis.

* Corresponding author. Tel.: +55 21 2629 5584; fax: +55 21 2629 5368.

E-mail address: ssmtavares@terra.com.br (S.S.M. Tavares).

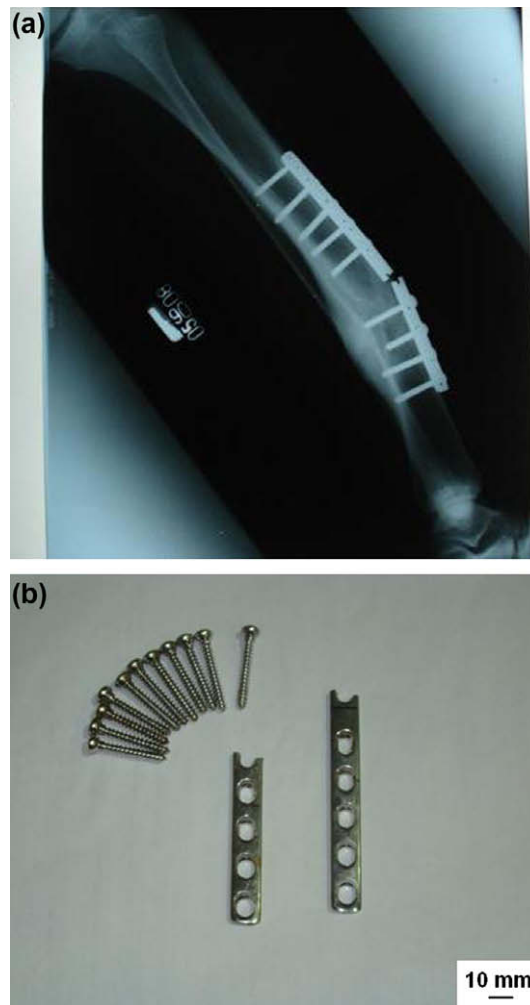


Fig. 1. (a) Radiographic pattern of implant 4 showing failure inside the patient; (b) the same implant after remotion and cleaning for analysis.

Table 1

Description and identification of specimens, with respective analysis performed, and time to failure.

Identification and description		SM	SEM	OM	CA	Time to failure
No.	Description					
1	Dynamic compression plate (large)	x	x	x	x	2.1 years
2	Dynamic compression plate (large)	x	x	x	x	8 months
3	Dynamic compression plate (small)	x	x	x		3 months
4	Dynamic compression plate (small)	x	x	x	x	2.2 years
5	Femoral plate	x		x	x	3 years
6	Dynamic compression plate (small)	x		x		3.8 years
7	Dynamic compression plate (large)	x		x	x	1 year

SM = stereomicroscope analysis; SEM = scanning electron microscope analysis; OM = optical microscope analysis; CA = chemical analysis.

2. Methodology

Seven orthopedic implants were removed from patients of Brazilian public health system, cleaned and sterilized. Table 1 shows the identification and description of each one of the components analyzed. Approximate time to failure of the seven implants is also informed in Table 1. In case of implant 2 the patient did not follow the medical recommendations of resting in the post-operating period.

The materials investigation and failure analysis were conducted following the steps below:

Download English Version:

<https://daneshyari.com/en/article/774308>

Download Persian Version:

<https://daneshyari.com/article/774308>

[Daneshyari.com](https://daneshyari.com)