Imperial College London

Templating Bone Shape for Surgical Accuracy

Total Knee Arthroplasty

indicated by

Osteoarthritis Pain [8]

despite

Multiple treatment modalities

affects

Quality of life

important factor

Coronal Alignment [15][21][26]

correlated with

Improved function of knee, physical quality of life, reduce pain [21]

leads to

Revison Surgery [14][22]

Malalignment & Instability [22][28]

Methods used

Manual Instrumentation

using

IM or EM guide [10][33]

Cheaper

Unreliable outcomes, regardless of surgeons' expertise [6][18]

Surgical Robot/CAS [2][6][9][12]

Increased alignment rates [6]

Patient Specific Instrumentation [4][7][16][17] [22][29][30][32]

Expensive, long preparation time, increased operative time, requires specialised training [6]

Custom surgical guides personalised to patient's anatomy [22]

Time-consuming pre-operative planning [20], specific software needed, legal and safety certifications required [7], little intra-operative adjustments

Expected to increase by 143% by 2050 [23]

used for

achieved by

can be overcome by

MARIO DEVICE

Hardware

Electronics

Low-cost camera module [1]

Optical Accessories

Contrast enhancement [31]

Optical Coating [35]

Lead Sulfide[24][35], Titanium Oxide[35], Lead selenide[27][35], Magnesium fluoride[35],

Non-polarising Filter[19][20]

Conceptual prototyping

use

Only small scale

Fast, cheap, many material options

Mechanics

Improvements (based on user feedback)

Optimise pin size, number and placement

Ease of use when drilling pins while holding device

Locking mechanism

Build two attachments for the distal epiphysis of femur and proximal epiphysis of the tibia [5]

Computer Aided Design

manufactured with

3D Printing

Metal Injection Moulding [11][13]

Rapid production and intricate geometries

Complex process

use

Final manufacturing technique

Component Design

Head Attachment

Captures shape of head of the bone

affected variables

Age, Race, Gender, Femoral Conditions [3][5][34][36]

Main Body

Allows device to be held in a comfortable and ambidextrous way

Phone Holder

Allows phone to be kept in sterile environment

Software

Navigation App

Device Control

Data Logging

Calibration

User Interface

Precision Calibration

Automated Calibration

Mobile Accessibilty

Intuitive Design